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ELECTRIC POWER IN THE SOUTH.

At a recent meeting of the American Cotton Manufacturers' Association, at Asheville, N. C., an instructive paper was read by W. S. Lee, Jr., chief engineer of the Southern Power Company. The paper dealt with the importance of electric power to the manufacturers of the South. A striking phase of this problem has been the apparent neglect of the many and important water powers in that section up to this time. This is explained not only by the fact that the South has been an agricultural rather than a manufacturing section, but because, when the railroads were being built there, there were practically no factories to influence the location of the lines, so that they were built merely with respect to the best location from the railroad engineer's viewpoint, which was along the highlands, and not in the valleys. This, as was pointed out, is diametrically opposite to the condition in New England, where the factories were well developed before the railroads were built, and the latter were forced to seek the mills; while, in the South, the factories were built after the railroads, and had to go to the latter. The result of this has been that the mills in New England were built where power is cheap, and cheap transportation was brought to them; while, in the other section, the mills sought the railroads, and, as a consequence, could not take advantage of the available water powers.

The condition has been changed now by the application of the electric drive, which, by means of a station placed at the water power, supplies cheap power to the mills already located on high and healthy ground close to the railroads. This new development has thus given the Southern mills an additional advantage over those in New England, besides that of being in the cotton country; and if full benefit be taken of these opportunities, and if the labor problems do not upset the forecasts, it is difficult, as Mr. Lee believes, to see what is to prevent that section of the country from becoming the main cotton-manufacturing centre of the world.

With such opportunities the manufacturers and engineers of the South have great responsibilities put upon them. If this development is to be carried out with the fullest success, many things must be borne in mind. A large water power is a valuable asset, but it can only be made to pay if the power produced from it can be sold. There must be a market or a fair prospect of creating one before the owners are justified in developing their property. On the other hand, the ability to secure cheap power gives one district a decided advantage over another not so favorably situated; yet it must not be forgotten that in most manufacturing processes the mere cost of power is a minor item. The great success of the electric drive can not be attributed to this feature alone. It is the other benefits accruing from its use which have put it in the lead. These water powers must therefore be developed intelligently and with a view to inducing manufacturers to build near them. Moreover, as undoubtedly a good deal of the capital required for this work must be drawn from other parts of the country, there should be no over-hasty running into hydroelectric construction. Such a policy would merely defeat its own ends by rendering capital suspicious. It is much better to go slowly, developing first at those points where there is already a market, and not rushing heedlessly into a hydroelectric boom.

There are a number of other problems now presented to the South which are related to this development. One is the preservation of the waterfalls by stopping the destruction of the

Southern forests. In some sections the danger of this destruction is already understood, but there should be a greater effort to impress the public with the importance of this matter. Then, too, the Southern states should provide better facilities for training their engineers. While at the present time there are a number of schools in the South where a good electrical training can be had, in most of the colleges the courses offered in electrical engineering, judging from the catalogue descriptions, are far from adequate. While it is true that the determined student can get his education by going to other states, there are many who are not able to do this, and there should be no such necessity. There is not the same neglect in other branches of technical instruction, and if, as has been predicted, electricity is to be the power behind the South, the colleges should see to it that properly trained men are provided to bring about this much-to-be-desired result.

GREENWICH OBSERVATORY IN TROUBLE.

A surprising situation has developed recently at Greenwich Observatory, England, which is, without question, one of the most important astronomical stations of the world, due to the putting in service near it by the London County Council of its new power station. The station is located exactly on the meridian, about a mile south of the observatory, and although it at present has but a small part of its complement, the entire equipment will have an output of over 50,000 horse-power. Already, some disturbance has resulted from the operation of certain generating units, and the observatory authorities have brought the matter before Parliament, as they fear that when all the machinery is in place and running, their instruments will become useless.

The surprising feature of this situation is that apparently no steps have been taken before to protect the observatory. Application for authority to build the power-house was made about four years ago, and when it was granted, other departments of the government, as well as private interests, were safeguarded; yet the observatory, the one institution most likely to be affected, seems to have been overlooked, and apparently its officers did not realize what was being done. Now they find not only that there is some vibration, but that the two large chimneys of the power-house, coming in the meridian, may possibly interfere with the observation of transits, not only on account of the chimneys themselves, but because of the hot gases which will pour out of them.

When this matter was up before Parliament a number of eminent statesmen and scientists spoke about the situation. Some suggested the substitution of steam turbines for the reciprocating engines; others suggested cutting down the height of the chimneys; but no definite conclusion was reached. It is probable that a commission, representing both the government and the London County Council, will examine the conditions thoroughly. In the meantime, careful studies are being made of the station to see if it can be rearranged so as to do away with the vibration. What the outcome will be can not be said definitely, but even though the power-house represents at the present time a value of about $2,500,000, it is hardly probable that for this sum the disabling of the observatory will be allowed; and yet, under the conditions, it does not seem fair that the taxpayers of London county should be made to pay for the negligence of a department of the government.

THE THREE-PHASE LOCOMOTIVES FOR THE SIMPLON TUNNEL.

The most recent application of the three-phase motor to electric railway operation is that which has been made in the Simplon tunnel. These locomotives, which were designed and built by Brown, Boveri & Company, Baden, Switzerland, are described on another page of this issue by Mr. B. F. Hirschauer. They were originally intended for the famous Valtellina road, but, on account of the recent completion of the tunnel, they were transferred there in order to begin the electrical movement of the trains. A short time ago it was reported in the daily papers that some difficulty has been encountered in using these locomotives in the tunnel on account of the hot, humid atmosphere, but it is hardly probable that this is serious, as the motors can be protected, or at least rendered sufficiently moisture-proof to do away with the trouble.

The equipment of the locomotive consists of two motors, as against the four used on the latest American types. Further, since these motors are of the induction type, they both must run at the same speed. It is therefore necessary to gear them together, otherwise the load upon them might be badly unbalanced; in fact, a serious unbalancing is likely to occur, due to a slight difference in the diameter of the driving wheels, if some coupling arrangement be not adopted. The motors are not geared to the axles. A system of side bars is employed, which is simply a flexible coupling, enabling the motors to move relatively to the axles.

The American locomotive most interesting to compare with this polyphase machine is that described by B. G. Lamme as the type selected for the New York, New Haven & Hartford Railroad. This is a single-phase locomotive, equipped with four gearless motors, spring-suspended from the driving wheel. The latter locomotive is designed to be used with 11,000 volts on the trolley. It calls for two single-phase transformers. The Simplon locomotives are intended for 3,000 volts only, and require a complement of three single-phase or one polyphase transformer. The four motors of the New Haven locomotive are rated at 200 horse-power each, but they can easily be overloaded so as to develop 1,000 horse-power. The Simplon motors are rated at 450 horse-power each, making a total of 900, but they also can be greatly overloaded. The American machine makes use of a multiple unit-control system, enabling two or more locomotives to be coupled together so as to obtain any desired tractive effort. This can not be done with the Simplon type.

It is probable that the Simplon tunnel offers unusually favorable conditions for the use of the three-phase type of locomotive, which is most suitable for fairly long runs with few stops. The type does not involve the use of commutators, the reliability of which in heavy alternating-current service is still doubted in

some quarters. Another characteristic of the polyphase type of locomotive is the limited speed range. There are but two economical speeds which are obtained by commutating the motors. The single-phase type has a variable speed characteristic, but is designed to develop forty-five miles per hour as a maximum. The speeds of the Simplon tunnel locomotive are twenty-five and forty miles an hour.

Mr. Hirschauer says that the Simplon motors weigh a little less than twelve tons each, and that they can develop a maximum output of 1,150 horse-power, which makes them the lightest motors for their size which have yet been constructed. This method of rating hardly seems fair, for it is probable that the output mentioned is that which the motor will develop just before dropping its load. It corresponds to what is almost a 100-per-cent overload from the normal rating. The motors could not, of course, be operated at any such load. It is possible that the single-phase motors, tested in the same way, would develop nearly as great an output per pound as the polyphase machine.

The total weight of the Simplon locomotive is said to be sixty-eight tons. It is intended to handle trains weighing from 200 to 250 tons. The weight of the New Haven locomotive has not been given, but it is to handle trains of approximately the same weight. The work of the two locomotives will therefore not be very different, considering only the single-phase machine as used for through service, and a more satisfactory comparison can be made when data secured from regular service are at hand.

A SAFE NOISE MAKER.

In commenting upon the reports of Fourth of July accidents, which, while possibly not as large as in previous years, still leave a great deal to be desired, our esteemed contemporary, the New York *Times,* says: "It would really seem that in the present state of science and art of chemistry the ingenuity of its professors and practitioners ought to be equal to arranging for some kind of noise which would not have too lethal consequences to persons or too destructive consequences to persons and property."

The opportunity here pointed out for a useful invention has already been seized upon in one instance, at least, and a safe noise maker has been constructed by the distinguished head of the physical department of one of our leading universities. This apparatus, which was described in this journal something less than a year ago, is a gas cannon, so-called because the explosive mixture is in gaseous form. It consists merely of a small toy cannon, a small acetylene generator and a couple of dry batteries for ignition purposes. By pressing a key the cannon is charged with a mixture of acetylene and air, and a touch upon a second key ignites the charge, producing a loud, sharp report. The cannon can be fired as rapidly as the gas will flow into it, at least as often as thirty times a minute, which should be frequent enough for any one. It is perfectly safe, for the hand can be held in front of the cannon mouth during a discharge without receiving any injury, and slight fabrics or tissue paper do not take fire when held in the flash, as the latter is almost instantaneous. If a louder noise is desired, a cork may be inserted, which then becomes a harmless projectile. The only drawback to the device is the first cost, but as this is not more than $5, it is probable that, bang for bang, it furnishes noise as cheaply as any other device, due weight being given to the size of the bang. If still bigger bangs are sought, any ingenious boy can add a horn to his cannon, or by firing it into the mouth of a barrel, he could raise a racket louder than the bolts of heaven. This noise maker has been for sale for nearly a year, but probably it is not widely known and therefore has been little used.

MAGNETIC SURVEYS OF THE OCEANS.

A very interesting article is contributed by Dr. L. A. Bauer to *Terrestrial Magnetism and Atmospheric Electricity* for June, in which he discusses the need for systematic magnetic surveys, and points out some of the important results accomplished by the survey which is now being made of the Pacific ocean, funds for which were provided by the Carnegie Institution. A brief summary of these results is given on another page of this issue. It is in such uses of the generous fund under the control of this institution that the greatest scientific good may be accomplished. Similar surveys on land are not so difficult, and they fall more properly in the work of the scientific departments supported by the various governments; but, as pointed out by Dr. Bauer, while thorough surveys are needed on land, it is on the water area that the need is greatest. The necessity for such surveys need hardly be urged when one's attention is called to the lack of reliable data, but the mere plotting of more accurate magnetic charts will be but a portion of the results accomplished.

As yet no satisfactory theory has been proposed to explain the earth's magnetism, and it is almost hopeless to expect to solve the greater problems pertaining to this until we have more complete knowledge of it. For instance, careful calculations made several years ago, and based upon the best data available, seemed to indicate to Dr. Bauer that the earth is losing its magnetism. There is no way of proving or disproving this phenomenon except by careful and thorough surveys. The indicated rate of shrinkage is so large that, if it exist and continue at the same rate, the earth will lose half of its present amount of magnetism in 1,660 years—a rather startling suggestion.

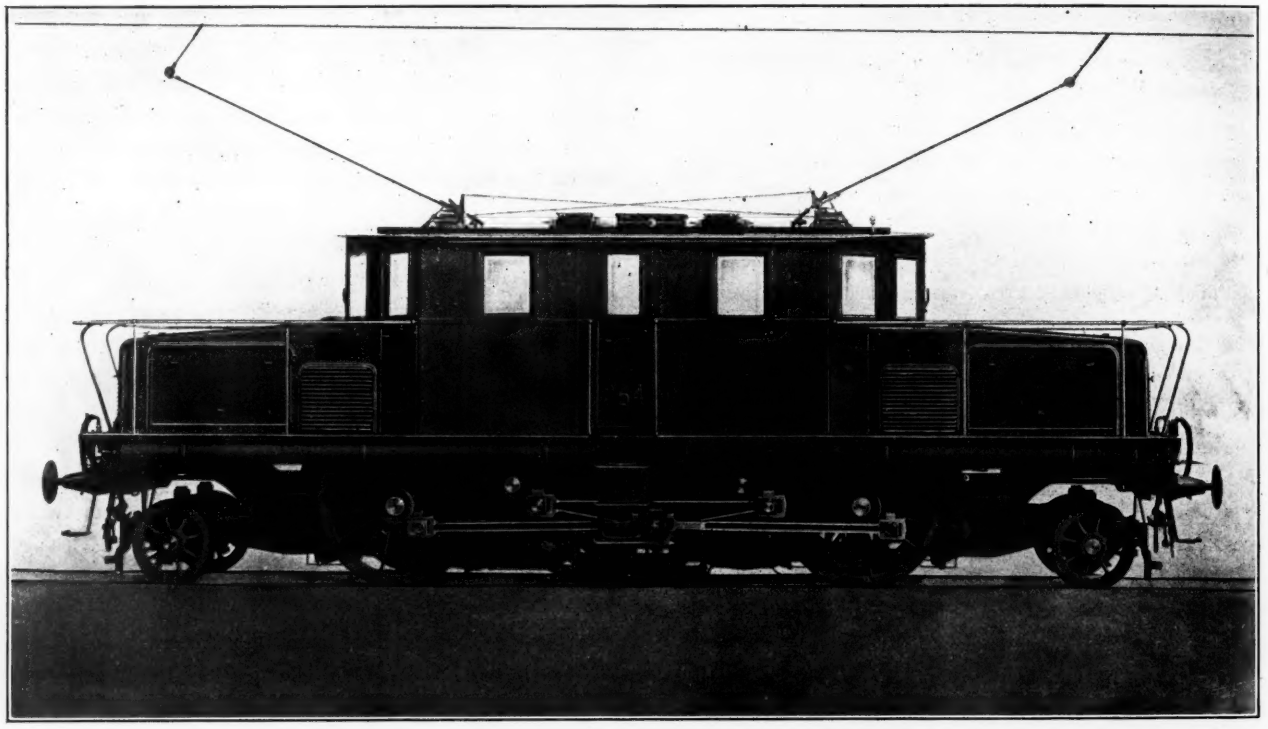
Another important problem is to establish some connection or to prove the entire independence of atmospheric electric currents and the earth's magnetism. Studies of the latter seem to point to the existence of a system of electric currents passing from the air into the earth, and in the other direction, but the values deduced for these currents do not agree with those observed by students of the atmosphere. Here again only more complete studies, both of the earth and the air, will lead to a definite conclusion.

The work already accomplished by the Galilee, the ship chartered by the institution, is only preliminary, but important conclusions have been reached, those of the greatest value probably being the demonstration that her equipment is thoroughly adapted to the purpose for which it is intended. We may therefore look forward to a most satisfactory survey, not only of the Pacific, but of the other oceans.

The Simplon Tunnel Electric Locomotives.

By B. F. Hirschauer.

THE new electric locomotives which have been built in order to carry the traffic of the Simplon tunnel are of especial interest as showing the latest progress in the way of designing a locomotive for running upon high voltage three-phase current. In the present description are given the main lines of construction which have been followed, with special reference to the novel features which are to be found in this case. There are also a number of views of the locomotive and motor, which show the general design. These locomotives have been built in Switzerland, at the works of Brown, Boveri et Cie., of Baden, who have furnished the writer with the following information.



THREE-PHASE LOCOMOTIVE TO BE USED IN THE SIMPLON TUNNEL.

Several years ago the Italian railroad system known as the Rete Adriatica established a concourse for the new electric locomotives which were to be used on the Lecco-Colico-Chiavenna railroad. This concourse was laid out under the following specifications.

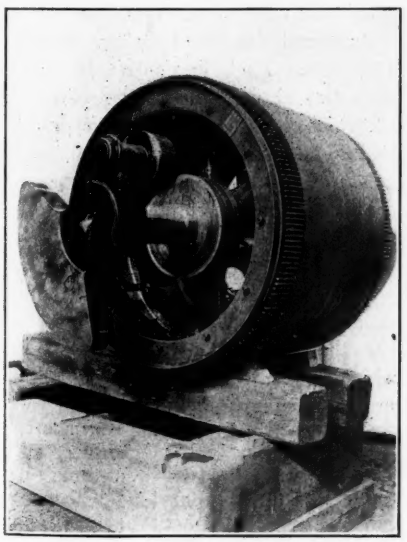
The locomotives are to consist of a frame which contains the main part of the electrical apparatus, and is supported upon two trucks. The latter have two axles each. Upon the frame is placed the upper body or housing of the locomotive, which is arranged so as to hold the remainder of the electrical outfit. The locomotive body is required to be built of such a shape as to give an easy and safe passage between it and the cars which are coupled to it at the ends. They are to be built according to the standard gauge of the Italian railroads, taking into account the contact shoes for the third rail. The maximum weight allowed upon each of the driving axles is not to be greater than fifteen tons.

The distance between the wheel centres of each of the bogies is fixed at a minimum of seven feet six inches, while the two inner axles are not to be less than nine feet eight inches distance apart. These latter axles are used as driving axles, and the wheel diameter is limited between four feet eight inches and five feet seven inches. For the transmission of the movement from motor to driving wheel the use of gearing has been excluded, and an especially solid construction is required for the motor support so that there shall be no movement either of the fixed or the rotating part of the motor, even should one of the springs be broken.

As regards the speed and the weight of the locomotive, it was found desirable to fix these points after the following conditions, which are based on previous experience. The locomotives are to be designed so as to allow two normal running speeds, which are to be obtained by the proper switching of the circuits. The power which is to be used in this case is 3,000-volt, three-phase current at fifteen cycles. Proper switching devices are to be supplied for cutting the high-tension current entirely off the motors when desired. The two standard speeds for running the locomotives have been fixed at twenty to twenty-five miles an hour for the first speed and from thirty-five to forty miles an hour for the second. The tractive effort of the locomotive at the normal speed is to be at least 6.6 tons at the wheel periphery for the slow speed and forty tons for the high speed. To allow for the proper starting of the locomotives, they are required to take a total load of 440 tons, including the weight of the locomotive, up a straight track having less than 1 : 1,000 grade, bringing the train from a position of rest up to the speed of twenty miles an hour in not more than fifty-five seconds. Again, a lighter train, weighing 280 tons along with the locomotive, is to be brought from rest up to a speed of

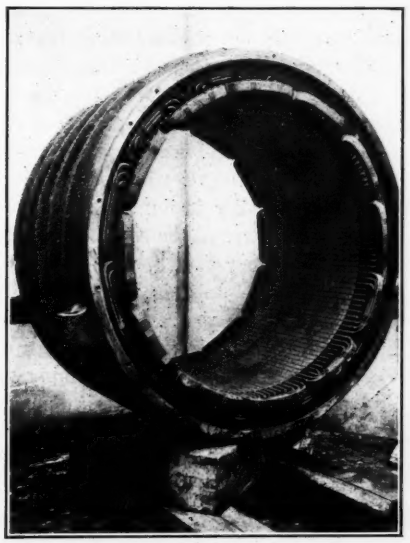
thirty-five miles an hour within 110 seconds, with the same conditions of track. In this number of seconds is included the time which is required for switching over from the slow speed to the high speed of the motor. These conditions must hold good even should the pressure of the line fall as low as 2,700 volts, and should it rise twenty per cent above the normal, the 280-ton train is to be brought with safety to the twenty-mile speed. The motors, resistance and the other electrical apparatus must be designed so that a load of 440 tons running upon a track with curves of 580 feet maximum radius and grades of three per cent following each other three times at least in a two-minute interval, can be brought from rest up to a speed of twenty miles an hour without any damage or overheating of the apparatus.

The new three-phase locomotives were designed according to the above conditions by the Brown-Boveri company, using the formerly constructed Valtellina locomotive as a model. This latter is a four-axle locomotive, and while keeping some of its features, it was desired to improve it considerably, especially from a mechanical standpoint. The main improvement which we find in the new locomotive over the old type consists in a change in the design of the frame. In place of using two half-locomotives coupled together, which showed some weak points in running, there is now a single and very solid frame mounted upon two trucks, each having two axles. The new locomotives,



Rotor of Simplon Locomotive Motor.

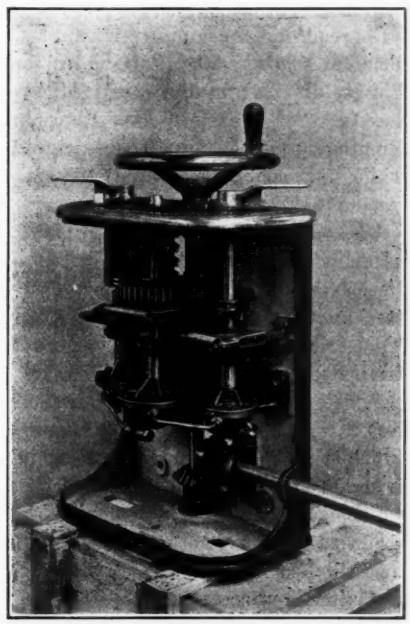
like the former type, are provided with improved apparatus for giving the two standard running speeds. At the same time the efficiency of the motors and the tractive effort have been increased in the new type. On account of the disadvantages arising from the use of three-phase motors mounted direct upon the driving axles, the Brown-Boveri company has designed a five-axle, two-truck locomotive, with two three-phase motors placed between the driving axles, in the inner space between the two trucks. The motors are coupled to the driving wheels by a driving bar, and at the same time the motor casing is utilized to form part of the locomotive frame. The method of driving will be observed in the view which shows the elevation of the locomotive. The two motor shafts are connected by cranks to a common driving bar which runs across between them. From the middle of this driving bar pass two side bars which are connected on either side with one of the driving wheels of each truck.



Stator of Simplon Locomotive Motor.

These locomotives had been constructed with a view of using them upon the Valtelline electric railroad, but before they left the factory it was desired to change their destination and to use them for the Simplon tunnel, so that they could be put in operation in the early part of the year. At the request of the Brown-Boveri firm, the Italian government decided to employ the locomotives for the latter purpose.

The principal dimensions of the Simplon locomotive are as follows. Distance between outer driving wheels, sixteen feet six inches. Centre to centre of axles in each truck, eight feet four inches. Length of the locomotive between buffers, forty-one feet eight inches. Diameter of driving wheels, five feet six inches. Diameter of outer wheels, two feet ten inches. Total weight of locomotive, sixty-eight tons, of which the mechanical part is thirty-seven tons and the electrical outfit thirty-one tons. Weight on drivers, forty-six tons. Capacity of the two motors in



Controller for Simplon Locomotive.

normal running, 900 horse-power. Maximum capacity, 2,300 horse-power. Weight of each motor with driving bar and counterweight, 11.8 tons. Normal speeds, forty and twenty miles an hour. Tractive effort at the high speed, normal 3.8 tons; maximum, ten tons. At the slow speed, 6.6 and 15.4 tons.

It is to be remarked as regards the weight of the motor, 11.8 tons, that for the maximum capacity of 1,150 horse-power which it will yield, this is undoubtedly the lowest weight which has yet been obtained for this capacity. This reduction in the weight of the motor has been brought about by the choice of the system of electrical connections, which avoids the method of series coupling used in the old locomotives of the Valtellina system. In this way a gain over the former type of motors of 2.8 tons per motor is effected.

The design of the new three-phase motors will be observed in the present engravings, which show the different details of construction. The two standard speeds of twenty and forty miles an hour for the locomotive are obtained by a new system of coupling the stator windings so as to form sixteen or eight poles. In this way a change in the speed from 112 to 224 revolutions per minute is made. The normal capacity of the motor when in regular use on the road is put at 390 horse-power at the twenty-mile speed and

450 horse-power at the forty-mile speed, using a tension of 2,700 to 3,000 volts at the terminals, working at fifteen cycles. Tests which have been made upon the new motor show that it can be run as high as 1,150 horse-power for short periods, and on a continuous running it will yield about 575 horse-power. The phase coupling is different in the case of the two speeds. For the slow speed the stator winding is coupled on the delta system, while it is connected on the star system for the high speed.

The outer field casting of the motor is of cylindrical form. It is built of cast steel and has a set of strengthening webs cast on the outer surface. Ventilating holes bring a good air circulation into the laminated iron. The revolving part of the motor is also well cooled on the interior. It is wound for six phases, of which three phases form one group, and it is designed so that the change in phase which is given to the stator produces a corresponding change in the rotor automatically, so that a separate switching of the latter is unnecessary.

The main controlling apparatus of the locomotive, which is shown in one of the views, has been well designed, and is of very simple and substantial form. It uses compressed air for operating the reversing switch and the pole-changing switch. A rod-and-gear-transmission device is used to connect it with the rheostat. The hand-lever of the reversing switch has three stop-points, forward, reverse and a middle point, in which case the lever is raised. In the forward and reverse points the air pressure is sent to the pneumatic switch, which is placed in the high-tension chamber, and by means of a piston device the latter switch operates the connections of the circuits for either direction of running. The pneumatic pole-changing switch is operated in a similar way. On the controller the lever for working it is provided with only two points, corresponding to the two speeds of the motor.

The main hand-wheel, which is placed between the two above-mentioned levers on the main controller, serves to operate the main rheostat of the locomotive for starting up the motors and for otherwise controlling the power of the latter. There are fourteen stop-points for the hand-wheel, corresponding to thirteen working points on the rheostat and one position where the rheostat is cut out. On the first of the working points, the rheostat is also cut out of circuit, but in this case the current is sent into the stator of the motor, as then the air-pressure is sent into the pole-changing switch and operates the latter. Then follows the normal working of the motor, using the slow-speed point on the pole-changing switch. To change over to the high speed, the resistance wheel of the main controller is brought back to the zero point, as before. The switching from slow to high speed and the short-circuiting of the rheostat is regulated by watching the ammeter reading. The switching can also be carried out by commencing with the pole-changing switch placed at the high-speed point, but there is then only one round of the controller, that is to say, thirteen points instead of two rounds of twenty-six points as in the former case. Cutting down the speed and stopping the motors is accomplished by bringing the controller back to the zero point, which cuts off the current by means of the pole-changing switch. An interlocking system is used on the controller, so that the reversing and pole-changing switches can only be operated when the resistance wheel is at the zero position and there is no high-tension current on the switch. By removing the reversing lever of the controller the valves of the reversing and pole-changing switches are automatically closed. These precautions render it impossible to make a false manoeuvre of the controller.

The emergency switch, which is shown in one of the views, is placed in the middle of the locomotive roof. It consists of an upper part containing the switching device, while the lower part, forming the oil-box, can be removed. It is operated either by hand or automatically in connection with the air-brakes, but not in the normal working of the latter, and also in case of short-circuit. The motorman can work this switch by means of a cord, if need be. It is also connected with the main controller by a pneumatic device, so that the emergency switch can only be closed when the controller is at the zero point.

A trolley is mounted at each end of the roof and works against the overhead wire. It is of a new design. For each trolley are provided two cutoff switches for the line. These are used to cut out one of the trolleys should there be a fault in the insulation, in which case the locomotive is run with the other trolley, either forward or backward. These switches are operated from a hand-lever placed on the roof, and a pneumatic locking device is used so that the handle can only be placed in the cutout position when the trolley is resting against the overhead wire.

A special housing or box is provided to contain all the high-tension apparatus of the locomotive, the reversing switch, pole-changer, ammeter switch, voltmeter transformer and fuses, the latter being placed in a separate box. The apparatus for each motor is placed separately, so as to allow of running with one motor alone. A single oil case contains both the reversing switch and the pole-changer, along with the piston apparatus for operating each of them from the controller. In order to prevent danger the high-tension box is closed by a special form of lock, and the latter is connected by a pneumatic device with the trolley-base. To open the box the trolley must be brought down from the wire, cutting off current from the high-tension apparatus.

For each of the motors is provided a separate rheostat of similar form. The rheostat is made up of wire-wound iron frames. Each rheostat has six separate frames, which can be easily removed, or two frames per phase. The frame is divided into thirteen sections in each case, and at the top is a set of removable contacts, so that any faults can be easily located. Regulation is carried out by carbon and copper brushes, which are operated by a chain transmission from the rod coming from the controller. To cool the rheostat, two air-fans are used, which are driven each by a three-horse-power motor. These motors are connected with the windings of the main motors, and diminish in speed until they come to a stop when the main motor is running entirely in synchronism.

In the motorman's cabin are placed a set of seven-kilowatt oil-transformers, which are used to run the air-compressor motors and for the lighting circuits at 110 volts. Each locomotive is provided with two automatic air-compressors, one of which is used for the Westinghouse brakes, and the other for the acoustic signals, the sand boxes and for the pneumatic control of the electric devices, as we have just seen. Either one of the compressors can serve for all the work if required.

As regards the design of the trolleys, it is to be remarked that the lower part has the form of a long parallelogram, which can be raised and lowered by air-pressure. The upper arm which carries the trolley contact is made very short and light. It has a limited swing on either side, and when used on the ordinary overhead line (at twenty feet above rail level), it works without having to move the main frame. The latter comes into play in the tunnels, where the wire is but fourteen feet above rail level, and in this case the air-pressure cylinder lowers the trolley arm. When needed, a small hand-pump supplies the air for starting up, and afterward the compressors come into action.

Street Railway Association of the State of New York.

Discussion of the Use of Hydroelectric Power at the Annual Meeting, Saratoga, June 26, 27.

AT THE twenty-fourth annual meeting of the Street Railway Association of the State of New York, held in Saratoga on June 26 and 27, there was an active discussion on hydroelectric power for electric railways. At this meeting were read the three papers on this topic presented by S. B. Storer, C. E. Parsons and G. A. Harvey, abstracts of which are given below. The extensive development of water power, both at Niagara falls and in the upper Hudson valley, has led hydroelectric companies to seek a market among the electric railways throughout central New York, and the discussion between the representatives of the supplying and consuming companies brought out some interesting differences of opinion as to the proper basis of charging.

CONTRACTING FOR USE OF HYDROELECTRIC POWER ON RAILWAY SYSTEMS.

BY G. A. HARVEY.

The effect of load-factor on cost of power is thoroughly understood where steam plants are concerned, but it might be supposed in the case of hydraulic power, where no furnaces have to be banked and inefficiency at light loads becomes unimportant, that the conditions would be different. Hydraulic turbines of modern design, however, usually have such characteristics that their overload capacity is very slight, and it therefore becomes necessary, if peak-loads are to be handled, to provide extra machinery to take care of these. With no provision for peaks it is still necessary to hold at least one generating unit in reserve, and a margin of capacity must be left unused in the operating turbines for gate travel in regulation, and to allow for partial clogging of distributors by refuse which accidentally enters the penstocks. As the water is available and costs no more if used to the full capacity of the plant, it is plain that the power-selling company will strive vigorously for a uniform load as high as is practicable for the installed machinery to carry. This results in making peaks a prohibitive element to power deals where the hydraulic plant has been some time in the field and has been able to discriminate in the choice of its customers.

The foregoing is not intended to convey the idea that railways can not contract advantageously for hydroelectric power. The typical street-railway load necessarily has prominent peaks, and, if these can not be smoothed down by adjustments of service, it is still possible, where a fair price is asked for the water power, to carry the heaviest part of the all-day load by means of this and the remainder by steam engines, gas engines or storage batteries, or combinations of engines and batteries.

If it is possible to make contracts for full-power requirements, it is usual for power companies to place some penalty rate on the peak-power or to arrange the terms of charge so that there are distinct advantages to the purchaser in keeping the load-line as nearly straight as possible. The most common method is to sell a solid block of "firm" power, which can be used at a load-factor of seventy per cent to eighty per cent or better, charging the minimum flat rate for this, and providing power above the firm amount on a kilowatt-hour basis at rates gradually increasing with the height of the peaks.

A very fair method of billing for power is on a sliding rate depending on the monthly load-factor. The maximum two-minute peaks are recorded in kilowatts each day and averaged for the month. The total number of kilowatt-hours for the month, divided by the kilowatt of this average peak times the number of hours in the month, represents the monthly load-factor. The charge for the month is then made up as follows: a definite service charge plus (load-factor times a fixed amount) times average daily maximum kilowatts. A moderate penalty for peaks is thus included, and the customer pays, according to the load-factor, as nearly for what he consumes as can be expected. This method of charging is now being offered extensively by one of the companies which is about to do business over a large portion of New York state. In effect it corresponds very closely with a flat-rate charge, but gives the purchaser a slightly less cost per kilowatt-hour at low load-factors.

If power companies can not entertain peak propositions at all, or if they place prohibitive rates thereon, the purchaser must then provide the steam plant or storage battery, or both, to care for a part of the load. In this case the hydroelectric power purchased should form the solid twenty-four-hour base of the area enclosed by the total load-curve, and should extend up to such height as to cover a chart area bounded at the top by a line closely corresponding with the base of the average daily fifteen-hour load-line (fifteen-hour load-peak). The purchaser should be allowed, without charge, swings of about ten per cent above the firm line of purchased power, provided the kilowatt-hours used above the line do not exceed those unused below it.

Very careful consideration must be given to proportioning the division of load to water power and steam power. It is hardly possible to evolve an exact formula for the location of the firm line of purchased power, and if one were worked out the weekly variations of load conditions would probably make its accuracy look doubtful. A safe point for this line is at such height that the fifteen-hour daily use of purchased power will be fairly close to it at all times. It is important, in starting to make this adjustment, to know the cost of steam power per kilowatt-hour at various load-factors under local conditions.

The possibility of power interruptions should be recognized in agreements and have penalties placed upon them. An interruption of six minutes is of comparatively small consequence to the railway and might be ignored if not repeated too frequently. Interruptions due to lightning, mistakes in switching, cable burn-outs, etc., are bound to occur, and six minutes is a reasonable allowance for testing cables and lines and returning power. Longer interruptions should entail forfeitures by the power company, increasing considerably in amount as the length of interruption increases.

In cases where steam plants are already in service on railway systems when the companies commence buying additional power, the interest, depreciation, etc., on these plants, although charged to total cost of power, should not enter into the cost of steam-generated power when balancing up the amount of this to be used in conjunction with the purchased power. The steam plant fixed charges continue, regardless of the power turned out, and only the actual operating expenses (coal, labor, etc.) should be figured against the steam power in this case. If the steam plant is installed, either at or after the time of contracting to buy power, the fixed charges might be considered as against "peak-power," but it does not alter the case materially in proportioning the

amount of steam power to be used. Operating cost per kilowatt-hour at various load-factors and the normal capacity and dependable overload capacity of the individual power station units are the governing features.

THE SALE AND MEASUREMENT OF ELECTRIC POWER.

BY S. B. STORER.

Since the day when the first commercial electric light entered the field of artificial illuminants, there have been endeavors to find an equitable way of charging for energy supplied in the form of electricity. The fact of the matter is that neither the straight flat rate nor the straight kilowatt-hour rate is equitable except when applied in connection with a definite load-factor—and even then it may not be entirely so, due to uncertainty as to the number of hours per day that full-load conditions prevail, with corresponding high efficiency, and to the hours during which operation continues at light loads with resultant low efficiency.

It is fully recognized now, however, that the load-factor is the root of the trouble, and unless a system of charging gives due consideration to it there will always be inequality of rates and dissatisfaction on the part of the power company or of its customers, or of both.

With the hydroelectric plant the cost per horse-power per year is almost constant, regardless of whether supplied one hour per day or twenty-four hours per day. Repairs are about the only variable, and they may be considered as increasing in direct proportion to the load-factor. Labor, oil, waste, etc., are nearly the same, irrespective of the proportion of light loads to full load.

With the steam plant, on the contrary, the items of coal, labor, etc., increase rapidly with the load-factor, and hence the cost per horse-power per year increases in almost the same proportion.

If we take up the case of a hydroelectric plant and transmission system with a wholesale cost of $30 per horse-power per year, and attempt to make a flat rate to all consumers, we quickly find there is little demand for power, as nearly every consumer has an intermittent load, or, in other words, a low load-factor, and can not afford to pay or will not pay the price it is necessary to ask for flat-rate twenty-four-hour power. It then becomes incumbent on the power company to devise a system of charging that will not only enable it to market its output, but to do so at prices that will secure a net revenue for the power equal to $30 per horse-power-year, besides an additional amount sufficient to cover the cost of retailing or distributing it, and further to enable it to sell at rates low enough to be attractive to consumers.

In the proposed system everything is sold on a maximum-demand basis, with the rate per horse-power per year varying between fixed limits in accordance with the consumer's load-factor. The load-factor is computed on the basis of a twenty-four-hour day; the kilowatt-hour consumption per day, divided by twenty-four, being taken as the average demand. The maximum demand is taken as being the highest rate of consumption for any one minute during the day.

Assuming that a manufacturer has made a contract to buy 400 horse-power for the operation of his factory, and that the rate per horse-power-year varies between the limits of $16 and $43, depending on the load-factor, the determination of his rate per horse-power per year for any given month would be as follows:

If the kilowatt-hours consumed during a thirty-day month are 43,200, then the average demand for power is 43,200 divided by 720 (the number of hours in the month), equal to sixty kilowatts or eighty horse-power. Assuming further that his maximum demand each day was just 400 horse-power, then, of course, his average maximum demand for the month will be the same amount, and the load-factor is eighty divided by 400 = 0.2, or, as commonly expressed, twenty per cent.

If the rate per horse-power-year varies between $16 and $43, it will be evident that the variable quantity is the difference between $16 and $43, or $27. The rate is therefore equal to the minimum rate ($16) plus the load-factor (0.2) times the variable ($27). Two-tenths of $27 is $5.40, so the rate per horse-power per year for that month will be $16 plus $5.40 equals $21.40. The total charge for the month would therefore be 400 times $21.40 divided by twelve, or $713.33. This is equal to 1.65 cents per kilowatt-hour. If his use of the power had been such as to give a load-factor of thirty per cent, the rate per horse-power per year would have increased to $24.10, but the equivalent cost per kilowatt-hour would have decreased to 1.24 cents—a reduction of almost twenty-five per cent in cost per kilowatt-hour due to increasing the load-factor to thirty per cent.

This may readily be put in the form of an equation which, if the desired rate per horse-power per year is R
the minimum rate limit is A
the maximum rate limit is B
and the load-factor is L
is expressed by $R = A + L\ (B-A)$.

This method is much more equitable than that sometimes used, of selling all the power on a kilowatt-hour basis with a guarantee from the consumer of a specified load-factor. A better way of charging—certainly a much more equitable way—would be to sell the power on a maximum-demand basis with the rate varying between the limits of, say, $18 and $38 per horse-power-year. With this way of charging there is a continual inducement held out to the consumer to increase his load-factor. The power company would probably also increase its profits somewhat by the increase in load-factor, but only to a comparatively small extent.

With such a system of charging established, having for its basis the load-factor of the consumer, the question immediately arising will be as to the manner in which the limiting values per horse-power per year are established, with power companies of different capacities to supply demands of all kinds and sizes.

Referring to the assumed case of a hydroelectric plant and transmission line wherein the wholesale cost is $30 per horse-power per year, and further assuming that the rated capacity of the system as a whole is 10,000 horse-power, we then have a basis with which to start. If power is to be furnished to consumers having a load-factor of approximately 100 per cent and sold on a straight flat rate per horse-power per year, then the cost of retailing the power in small amounts will increase the cost as the amounts decrease.

If, however, the consumers operate at a low load-factor, the power company may "oversell" its plant to an extent directly dependent on the relation between the capacity of its plant and the amount of firm power sold to each one. As a matter of actual practice the ratio is about three to one.

The same system may also be applied to steam plants if consideration is given to the range in cost due to change in load-factor. Greater leeway as to permissible intermittent demands could also be given, due to steam engines being capable of temporary overloads to a much greater extent than are water-wheels. The general principles underlying all power plants of whatever type are, however, the same; and one system of sale and measurement of their output, giving due considerations to

local conditions, would, if universally used, do much to establish a better relationship between producer and consumer—if, as in the one proposed, it is founded on equity.

SALE OF WATER POWER FROM THE POWER COMPANY'S POINT OF VIEW.

BY C. E. PARSONS.

There are three important factors which have to be considered in determining the cost of hydroelectric power for a railway system: the first cost of the power plant and distributing system, the amount of power to be delivered, and the load-factor.

There is no reason to expect a railway manager to consider a proposition for power unless there is a saving over the cost of operation by steam, and the stumbling block in the way of a contract is usually the amount of this saving. The railway companies as a rule are not thoroughly conversant with the first cost of a plant and distributing system, and do not realize the magnitude of the interest and maintenance charges.

One of the largest items in the cost of a system for supplying power is the substation and apparatus. The total cost of the distributing system, including transmission lines and substations, is about equal to the cost of the generating stations.

The second item to be considered in determining the cost of hydroelectric power is the total number of kilowatt-hours required. It is self-evident that an average load of 2,000 kilowatts is more to be desired than a load of 500 kilowatts, as the fixed charges and operating expenses of the distributing system in either case are practically the same. This is not exactly true in regard to the interest on copper and distributing apparatus, but this item is small compared with the operating expense and depreciation on lines, etc.

The load-factor is the third and most important item in determining the cost of power, load-factor being the ratio of average to maximum load. It is evident that when the load-factor is near 100 per cent all of the machinery is in operation on all parts of the system, and the transmission lines are carrying their full load; the entire investment will have an earning power, and the charges will be a minimum per kilowatt-hour. This is an ideal condition, and one which can not be realized. Nevertheless, it has to be used as a basis to work from in determining the cost with various load-factors. If a plant is built for supplying power for a railway only, the cost per kilowatt-hour will be higher than where power is also supplied to factories and for lighting purposes. In a large mixed system consideration must be given to the loads which are on at a time when the railway demand is low and when the machines set aside for railway purposes can be used for partially carrying other loads. The value which is to be given to these separate loads must vary according to the character of the load and the time of year.

There are two methods which may be considered in making contracts for railway energy. One is the flat rate per horse-power per year, based on the maximum demand; the other method is on the kilowatt-hour basis. In either case a fixed amount of power as the maximum load is agreed upon, and momentary overloads of five per cent or ten per cent are allowed.

With the flat-rate method the power company is not interested in the load-factor, and the burden falls on the railway company. The only way for the railway company to take advantage of the cheaper hydroelectric power is by the use of storage batteries or by the operation of an auxiliary plant to carry peak loads.

With the second method of charging on the kilowatt-hour basis the power company must be protected by a minimum monthly payment. This minimum payment must be determined by the average load-factor. The load-factor, therefore, is the basis for determining the cost with the kilowatt-hour method.

The items to be considered in fixing the cost to the railway company per horse-power per year are the fixed charges, consisting of interest, depreciation, taxes and insurance; the cost of manufacture, consisting of labor, repairs and supplies; the cost of distribution; and the cost of management. There should then be added a reasonable dividend on the stock. The sum of these items, less the dividend, divided by the average amount of power which can be supplied at the distributing stations throughout the year, determines the cost per horse-power per year to the power company. This cost with large customers determines the price which they are to pay for energy. If, now, the power company is to be subject to the loss of income due to apparatus being idle for a part of the time, on account of low load-factor, the railway company's cost per kilowatt-hour must be correspondingly increased.

The gist of the matter is that with the flat-rate method, in order to obtain the benefit of the cheaper power, the railway company must make an investment in either a storage battery or an auxiliary power plant and bear the interest and depreciation of the same; while with the kilowatt-hour method the rate to the railway company is higher, but the power company bears the interest and depreciation of the apparatus which is idle part of the time, but which must be maintained in readiness to supply the maximum demand. In the kilowatt-hour method consideration should be given to the factory and lighting loads whose peaks do not overlap the railway load. In this manner the load-factor on each individual machine is increased and the railway company derives the benefit of this greater load-factor. In other words, the railway load-factor may be forty-five per cent, but by means of the loads which can be carried on the plant the average load-factor on the machines supplying the railway company, which are usually running in parallel with some of the other machines, can be built up to say seventy per cent. This load-factor of seventy per cent is used instead of forty-five per cent in determining the cost of the power for the railway company.

To analyze the methods of determining the cost, a concrete example will be given. The figures used are for comparison only and do not represent conditions of operations.

The maximum railway load is 3,000 kilowatts, or 4,000 horse-power, and the load-factor is forty-five per cent. Considering the fixed charges and cost of operation, it is determined that the value of the power at the railway company's substation is $100 per horse-power per year. The cost to the railway company with the flat-rate method will, therefore, be $400,000 per year, or, if the full amount of power could be taken for twenty-four hours per day every day in the year, the cost would be $.0153 per kilowatt-hour. With a load-factor of forty-five per cent the average power would be 1,350 kilowatts, or 1,800 horse-power, and the cost would therefore be, with no storage battery on the system, $.0338 per kilowatt-hour. The cost to the railway company is therefore $100 per horse-power per year, based on the maximum amount of power used, and the cost based on the average of 1,800 horse-power used is $222 per horse-power per year. On account of the great cost per horse-power per year based on the energy actually used, the railway company is compelled to install a storage battery and decrease the maximum demand. The maximum demand will therefore be 1,350 kilowatts, the average load, plus a battery loss of approximately 350 kilowatts, making the maximum demand on the power company 1,700

kilowatts, or 2,260 horse-power. The cost to the railway company for the hydroelectric power will therefore be 2,260 horse-power times $100, or $226,000 per year. To get the total cost for power there must be added the interest and depreciation of the storage batteries, which will amount approximately, on a comparative basis, to $30,000 per year, making the total cost to the railway company $256,000.

With the kilowatt-hour method the value of the power at the distributing station is the same, or $100 per horse-power per year, or $.0153 per kilowatt-hour. Instead of using the load-factor of forty-five per cent in determining the cost to the railway company, the railway company is given the benefit of the average combined load-factor of the generating plant. This load-factor is seventy per cent, and the cost to the railway company is $142 per horse-power per year for power actually used, or $.021 per kilowatt-hour. The total cost, therefore, to the railway company is 1,800 horse-power times $142, or $255,600 per year.

The power company must have a minimum guaranteed monthly payment based on the maintenance of the load-factor by the railway company. The power company is also protected by the maximum demand which can not be exceeded, and is assured of a stipulated income; so that if the railway company's load-factor drops below whatever amount is stated in the contract, the railway company will be the loser by reason of paying for power which it has not used. Thus the railway company derives the benefit of the larger combined load-factor of the plant in determining the cost per kilowatt-hour, but is obligated, by reason of the minimum payment, to keep its load-factor within reasonable limits.

It is evident that the actual cost in either case is approximately the same, but with the flat-rate method the railway company has to make a larger investment in order to take advantage of the hydroelectric power.

In opening the discussion, G. A. Harvey, of Buffalo, presented several curves; one showed an example of economical location of the "firm" line, and the other two gave the cost of power for various load-factors, figured from data given in Mr. Storer's paper.

W. W. Cole, of Elmira, referring to Mr. Storer's paper, pointed out that the cost per horse-power per year increases rapidly with the load-factor. In Mr. Parsons's paper the author says: "The load-factor is the third and most important item in determining the cost of power." The same thing applies to the steam station apparatus. The steam apparatus is working on the point of economy when it is carrying a normal rated load, but when used for carrying peaks there is put upon it the kind of load which is most expensive. Unless a storage battery is installed to carry a given load beyond the normal load, the cost per kilowatt-hour of these peaks will be brought up to about twenty cents.

The question of determining just what can be carried is difficult. For instance, on a station carrying 5,000 kilowatts, there may be a firm load of anywhere from 3,000 kilowatts to 3,500 kilowatts, but a storage battery would have to be used in conjunction. The peaks of about 500 kilowatts run from one-half hour to an hour a day. In carrying such a load on an auxiliary steam plant it would be necessary to charge up to say twenty cents per kilowatt-hour for the peak power. On many roads in the summer months, where there is a pleasure ground, it is sometimes necessary to start off thirty to forty cars in half an hour. Yet this peak period may come on only twice in twenty-four hours. With an electric light plant there are many large office-building loads coming on for about an hour a day. Still the company must pay for the twenty-four hours on account of that hour when the load runs above the firm-load line.

W. J. Harvie, of Utica, said his company purchased hydroelectric power on the kilowatt-hour basis and from its standpoint this method seems all right.

T. W. Wilson, of Buffalo, agreed with Mr. Harvie on the way to pay for power. When a company can get down to a kilowatt-hour basis it knows what its power is going to cost. Mr. Harvie had figured it out for the Buffalo proposition, and found it very much more expensive to buy power based on peaks.

J. H. Pardee, of Canandaigua, asked what was the difference between one-minute and two-minute peaks, that is, whether the two-minute peak could be allowed with safety by the power company instead of a one-minute peak. It appeared to the speaker that a two-minute peak could be allowed as well as the shorter one, as the difference to the railroad company seemed to be much more important than to the power company. For instance, in the plant described by Mr. Parsons the turbines have considerable overload capacity. It is quite unusual that the turbines should be rated so much higher than the generators. In the case of Mr. Parsons's plant, a two-minute peak should be no hardship at all. If the machines had no overload capacity it would be more of a hardship.

Mr. Storer said, in reference to one or two-minute peaks, that in connection with the system of charging explained in his paper, if a two-minute peak is used it would mean that the probability of peaks overlapping on different railway or other loads is increased just double. The power company could not oversell its plant with two-minute or longer peaks as easily as it could with one-minute peaks. The speaker had found in the negotiations he had had with power customers that they all look at their individual conditions and try to get a time limit on their peaks long enough to take in their maximum demand. For example, one customer had a load to carry up a hill which would mean a fifteen-minute peak. The customer thought the company ought to sell him power on a fifteen-minute peak. It does not make any difference what the peaks are, the income must be a certain amount, and if the load-factor is based on a one-minute peak to determine the cost per kilowatt-hour, it all comes to the same cost per kilowatt-hour, because the kilowatts consumed on a five-minute peak are more than on a one-minute peak. As far as the question of selling power on a kilowatt-hour basis pure and simple with a guaranteed load-factor is concerned, the consumer runs against the same thing as on the maximum-demand basis. From the Niagara, Lockport & Ontario Power Company's standpoint, that company considers it much more to the consumer's advantage to be permitted to take these peaks and pay for them only when they occur, rather than have the circuit-breakers throw off the entire load and interrupt the service, if only for a few minutes. According to Mr. Cole's remarks on peak loads, he counts the load he gets in the summer time for the park service as put on as an addition over the firm-load line. On top of that he puts the lighting load from buildings and some other kind of power service. The chances are that in Mr. Cole's particular case the park load in summer will come at a time after the ten-hour factory load is off. It will also come when the lighting load in offices is not a factor. Therefore, taken as a whole, the same law of probability would enter in that case. The point of measurement being the same for all these different usages, the total peak would be very much reduced below the individual peaks of each class of service supplied by

the buying company. Therefore the retail company could oversell this purchased block of power in the same way that a power company can oversell the capacity of its plant.

C. L. Allen, of Utica, said that approximately seventeen per cent of the gross receipts of the electric railways in the state of New York is paid out for power, according to the report of the New York State Railroad Commissioners. The Superintendent of Public Works, in his annual report four years ago, called attention to the fact that the state of New York, aside from Niagara falls, had more undeveloped water power than any other state in the nation. It seems to have taken us a long time to discover that hydraulic plants are available as a source of cheap power. It also seems to be a fact that when a traction and power company begin to negotiate they start from a common point but proceed in opposite directions. The question of whether hydroelectric power is the right thing for a traction company to use depends, first, upon the price and, secondly, upon the quality of the service. If the price and service are as good as with a steam plant, there is no doubt that the traction interests are suffering by not purchasing hydroelectric power. Whether such power service will prove satisfactory or not depends a great deal upon the form of contract. In the past five years the Utica & Mohawk Valley Railroad Company has had three forms of contract, two unsatisfactory and the third satisfactory. It has been operating under the latter since July 1, 1905, and it has proved mutually satisfactory. The first contract was for block or firm power, to be paid for at so much per horse-power per year, measured by a horse-power meter. The maximum demand for the month was to be regarded as seventy-five per cent of the average maximum demand, and was to be paid for at the rate of $25 per horse-power. All power in excess of this seventy-five per cent was to be paid for at the rate of $33 per horse-power per year. That was not satisfactory either to the railway company or to the power company, and was repudiated by both. As an arbitrated agreement, the railway company purchased power for two years on the kilowatt-hour basis, the railway company having no power plant that it could use. The price in that contract was so high that instead of paying 16.66 per cent of the gross receipts for power, the railway company paid 32.8 per cent for two years. The present contract is not wholly a kilowatt-hour contract. The railway guarantees a minimum load per month, and if the total kilowatts used in one month do not clear a certain amount, the railway company must pay the minimum anyway. There has been but one month when the total kilowatts used have fallen below the minimum. The quality of service that has been received in the past year has been satisfactory in every way. The contract, besides being a hydroelectric contract, embodies two other features which have not been spoken of. As a supplementary contract, there is a steam-power plant which the power company maintains and agrees to have ready on thirty minutes' notice; the other is the penalty feature. But the railway has never yet penalized the power company.

Mr. Wilson said the International Railway has two forms for contracting for hydroelectric power. It pays a certain price in Buffalo for 7,000 horse-power firm, and at another rate for the peak loads during the summer. In winter the peaks are carried by a steam plant. On the interurban section a sliding firm line is used, excess loads being paid for by the kilowatt-hour.

Oren Root, of New York, said, in reply to a question, that the price of power in New York city is about $.006 per kilowatt-hour.

J. H. Pardee, of Canandaigua, said he had found that the charge frequently made by hydroelectric stations for "readiness to serve" amounted to about eighty per cent of supplying the peak loads from a steam plant.

A Method of Starting Gas Engines.

An ingenious method of starting gas engines has been devised by Louis Renault, of Billancourt, France. The device is primarily an ignition magneto driven by means of a friction coupling, but it is arranged so that when the engine is standing the coupling is free. The engine is arranged so that it is full of gas whenever it is stopped, the admission valve being held open. To start it it is only necessary to throw a lever, which turns the magneto over, producing a spark in the cylinder, thus starting the engine, and throwing the magneto into gear with the friction clutch. If desirable the magneto may remain in gear with the engine and a supplementary device employed for the starting-spark.

Electricity in Elevator Service.

In order to get definite information as to the relative merits of electric and hydraulic elevators, S. M. Bushnell has collected records of the operating costs of a large number of elevators in the city of Chicago, Ill. These elevators are, for the most part, of moderate size, running from five to twenty-five horse-power. The records show an approximate efficiency on the part of the electric elevator about twice that of the hydraulic elevator using electric pumps. Figures given for five office buildings indicate that the energy consumed by the electric elevators is from 2.19 to 3.45 kilowatt-hours per car mile. These data are the result of a careful record of many trips made at various times during a year. They check closely with data obtained in similar service in other cities. There were found in Chicago four hydraulic elevators operated by means of electric pumps, and the energy consumed by these averaged over six kilowatt-hours per car-mile. These figures also agree fairly well with similar service in other cities. As it requires nearly a kilowatt per horse-power to run the pumps, the average result is found to be reduced to about six kilowatt-hours per car-mile when allowance is made for the motor losses. Much has been said regarding the relative mechanical efficiency of hydraulic elevators as compared with other types. Some have claimed a mechanical efficiency for the hydraulic machine of over seventy-five per cent. However, the owner of a building does not care particularly about the efficiency of his elevator, as what he wishes is a machine which requires the least amount of energy to operate it. Figuring in this way, it is found that the net commercial efficiency of the most modern elevators runs far below the figures mentioned. Assume an electric elevator of the drum type operated in a modern tall office building, and let it carry on an average six persons from the top to the bottom of the run. This is probably a favorable assumption. On this basis it is found that the actual efficiency as a transporting device is about thirty-three and one-third per cent. Figured in the same way, the efficiency of the hydraulic elevator will be about one-half this, or sixteen and two-thirds per cent. It is very probable that the greater number of electric elevator installations are operating to-day at an efficiency of not over twenty per cent, and hydraulic elevators at about ten per cent. Evidently, in spite of the great advance which has been made in elevator work, there is opportunity for still further improvement.—*Cassier's Magazine, July.*

The National Electrical Contractors' Association.

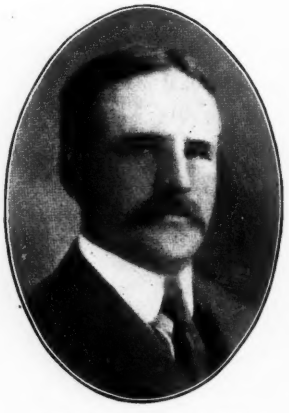
Sixth Annual Convention, to Be Held at Cleveland, Ohio, July 18, 19 and 20.

THE sixth annual convention of the National Electrical Contractors' Association will be held at Cleveland, Ohio, July 18, 19 and 20. The Hollenden Hotel has been selected as headquarters. Through the efforts of Alexander Henderson, master of transportation, a rate of a fare and a third has been secured from the Central Passenger Association, the Trunk Line Association, the Western Passenger Association, the New England Passenger Association and the Southwestern Excursion Bureau. For the convenience of passengers from New York and adjacent points, arrangements have been made with the New York Central & Hudson River Railroad for a special Pullman equipment, to leave the Grand Central station, New York city, on July 17 at 5.29 P. M. The train is due to arrive in Cleveland on July 18 at 6.55 A. M.

Passengers from points south and east who desire to avail themselves of the lake trip may secure at Cleveland for the return journey transportation *via* the Cleveland & Buffalo line, whose steamers run daily between Cleveland and Buffalo. Passengers desiring to visit Niagara Falls on the return journey may do so by depositing their return tickets with the agent of the line over which their tickets read, immediately on arrival at Buffalo.

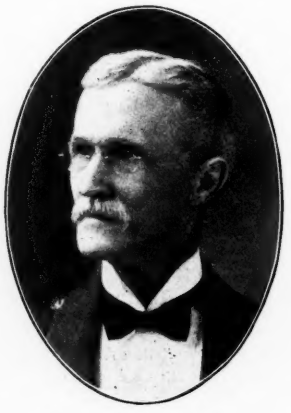
The National Electrical Contractors' Association was organized in Buffalo, N. Y., July 17, 1901. The meeting for this purpose was called by the United Electrical Contractors' Association of New York State. The association movement was first started by the formation of local associations in different cities in New York state. In August, 1899, these local organizations formed the United Electrical Contractors' Association of New York State. This organization met with strong support and proved such a factor in developing the opportunities of the electrical contractors that it was decided to issue a call for a meeting of contractors from all parts of the country. This call resulted in the formation of the association in Buffalo, as above mentioned. The Buffalo meeting was largely attended, and the national association was inaugurated with considerable enthusiasm. The organization has steadily gained, both in numbers and in power. The membership list includes contractors from all parts of the United States, and is thoroughly representative of the electrical contracting business. In connection with this association a monthly paper, called *The National Electrical Contractor,* is issued. This paper is not in any way a technical journal, but is devoted entirely to the interests of the electrical contractor.

JAMES R. STRONG, PRESIDENT.



W. I. GRAY, FIRST VICE-PRESIDENT.

F. E. NEWBERY, THIRD VICE-PRESIDENT.



JOHN R. GALLOWAY, TREASURER.

Much good can be accomplished by the getting together of the men who represent large expenditures of capital and the handling of large numbers of laboring men. The object of the association is to formulate plans for the equitable carrying out of business in every section of the country.

The present officers of the association are:

President—James R. Strong, New York, N. Y.

First vice-president—W. I. Gray, Minneapolis, Minn.

Second vice-president—Walter C. McIntire, Philadelphia, Pa.

Third vice-president—F. E. Newbery, St. Louis, Mo.

Treasurer—John R. Galloway, Washington, D. C.

Secretary—W. H. Morton, Utica, N. Y.

Sergeant-at-arms—J. C. Sterns, Buffalo, N. Y.

The directors are as follows:

Arkansas—T. B. Martin, Jr.; Connecticut—E. N. Baldwin; District of Columbia—Cyrus Mantz; Illinois—Arthur Frantzen; Indiana—G. M. Sanborn; Iowa—Edward Kunkle; Maryland—H. K. McCay; Massachusetts—Seth B. Wetherbee; Michigan—F. J. Miner; Minnesota—L. L. Sanford; Missouri—W. A. Corrao; New Jersey—Paul H. Jaehnig; New York—J. R. Strong, M. L. Barnes, James Hilton; Ohio—E. M. Lawton; Pennsylvania—E. R. Keller; Rhode Island—S. A. Potter; Wisconsin—George F. Rohn.

Quite recently an enquiry was raised as to the future opportunities for development of the electrical contractors of the United States. We are happy in being able to present herewith the views of a number of prominent electrical contractors concerning this important organization.

James R. Strong, president of the association, writes as follows:

"So far as the needs of electrical contractors are concerned, I think that their chief interest at this time is to devise means whereby the different lines of business can be separated, so that the manufacturers and wholesalers shall not con-

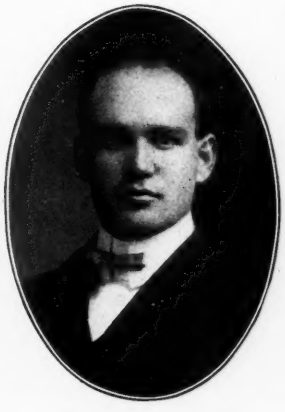
tinue to be competitors of the contractors, who are the legitimate retailers.

"You have, no doubt, seen considerable similar discussion on this subject within the last few months, and I feel that your valuable paper can confer a great benefit upon the electrical trade at large by urging some classification of the different kinds of business, so that the above-named competition may be done away with."

F. E. Newbery, third vice-president, writes:

"Reviewing the history of the evolution of the electrical contractor, one finds the progress made in the electrical industry has necessitated the employment of considerably more men in carrying out the installation work than were available for the purpose, the immediate result of this being the introduction of not a few more or less unfit, both as to technical education and in practical work.

W. H. Morton, Secretary.



T. B. Martin, Jr., Director for Arkansas.

G. M. Sanborn, Director for Indiana.

Seth B. Wetherbee, Director for Massachusetts.

"This condition of things naturally, in course of time, would right itself, as, in fact, it has been doing very rapidly the last few years. In the meantime, however, it behooves the electrical contractor himself to see to it that men of the proper material are educated up to the standard of requirements to-day. The electrical engineer and contractor nowadays must essentially have a thorough technical education and also a practical experience in some of the many important branches of the industry, in order to properly carry out the important engineering problems continually confronting him. To this end it will be readily seen that an association of electrical contractors can be a great help, both in the exchange of practical experiences and in the promulgation of new ideas.

"As an example, one might assume the case of an electrical contractor, in a small town or community, considered, no doubt, to be the best there is in his line, judged as he would be, by the best standards obtainable in the somewhat restricted field in which he is carrying on his business. This contractor himself knows, however, or very quickly finds out, when he comes in contact with the electrical engineers and contractors of the larger cities, that the rapid progress, year by year, makes it necessary for him to brush up against those who are up to date. This opportunity is afforded him by an association.

"The social features of an association should not be overlooked either. It is far pleasanter to feel that one's competitor is a friend; one would always rather lose to a friend than to an enemy. After all, one has only a life to live, so let us try to make it as pleasant for one another as possible."

John R. Galloway, treasurer, writes:

"The needs of the electrical contractor are better conditions in the retail trade; license laws for the better protection of the contractor and general public from incompetent and unskilled workmen; uniform interpretation of the underwriters' rules and rigid inspection of concealed work.

"The conditions of trade at this time are very unsatisfactory. Manufacturers, jobbers, contractors and, in some cases, the central stations compete for the same business. The central stations' business is to sell current, and they should advance every possible means to encourage the use of electrical devices, and leave the sale of all current-consuming devices to the retailer or contractor.

"Rigid inspection of all electrical work is of the greatest importance, and the enforcement of the rules will be a great benefit to those contractors who endeavor to execute good and honest work.

"The interpretation of the underwriters' rules should be uniform throughout the country. This will be of benefit to the contractor, wireman, customer and the inspection departments as well, and result in saving much expense to the contractor and much annoyance and inconvenience to the customer.

"A law requiring all contractors to be licensed should be in force in every state in the Union. Such laws can only serve the purpose of protecting the public and the conscientious contractor."

W. H. Morton, secretary, writes:

"The principal needs of the electrical contractors at this time are better conditions in the retail trade, uniform and reasonable inspection of work, license laws safeguarding the public from irresponsible and unskilled workmen.

"The conditions of the retail trade are such that at the present time the manufacturer, jobber, contractor and some of the central stations are competing for the consumer's business.

"While this is due to the phenomenally rapid growth of the business, it is a condition that is contrary to all established laws of trade.

"The manufacturer should distribute through the jobber, the jobber through the contractor or retailer, and the contractor sell the goods to the consumer direct.

"The central station is in the business to sell its current, and while it is entirely within its province to do everything possible to stimulate the use of current-consuming devices, it should not sell such devices in competition with the retailer.

"Inspection of electrical work is of vital importance to all contractors, and a rigid enforcement of the rules is a benefit to contractors endeavoring to do good work.

"It is necessary, however, that the interpretation of the rules throughout the

country should be uniform both on account of the contractor and the wireman.

"The rules as laid down by the National Electrical Code cover practically all conditions met with in actual practice, and they are fairly clear and distinct.

"The interpretation of the rules, however, varies greatly in different sections of the country, causing misunderstandings that result in expense to the contractors and inconvenience to their customers.

"Laws requiring contractors to be licensed are important to both the trade and the public.

"While electrical work properly put in is absolutely safe, improperly installed it becomes a menace to both life and property.

"A law requiring all contractors to be licensed should be in force in every state, and such a law should embody the following conditions:

"Each contractor applying for a license should be examined as to his ability to properly install electrical work.

"Each contractor should be required to pay a yearly license fee and to furnish a bond in a good-sized amount conditional on the proper installation of his work.

"It should make it a misdemeanor for any one not holding a license to install electrical work.

"Such a law would be a protection to life and property through its preventing the installation of unsafe electrical work and would not work any hardship on any one who was capable of properly installing electrical material.

"This National Electrical Contractors' Association is endeavoring to bring about a better condition in the business along all of the above-mentioned lines and should have the cooperation of all those interested in the improvement of the electrical business."

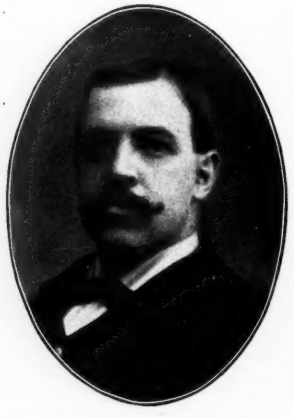
William A. Corrao, director for Missouri, thinks that the contractors need to get together, and that if more of them could attend the annual conventions and hear the experiences of the different members from every part of the country, the association would be three times as large as it is. He believes the convention is the greatest educator that the contractor could have.

M. L. Barnes, director for New York, writes as follows:

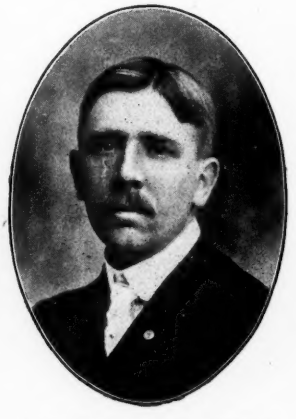
"The greatest need of the electrical contractor to-day is thorough organization. A business that has reached such vast proportions in such a time has hardly given those who have engaged in electrical construction and installation time to think of the results that would accrue by being able to obtain ideas from others in the improvement and safety of their work. Being but in its infancy and new devices being constantly introduced, the electrician can scarcely afford to keep within himself, but should aim to be in touch with these improvements and broaden out, with these conditions. There seems no better way than to throw aside the narrow-mindedness that has pervaded the profession, meet the competitor on a friendly and equal footing in an association having as its basis the fostering of trade, to reform abuses, to settle differences between its members and to promote more friendly intercourse among the craft.

"Could those who are still unattached to local, state or national electrical contractors' associations realize what changes have come as the result of organization, in trade and labor conditions, betterment of underwriters' rules and consequent improvement in installations, broadening of mind and education of the once narrow-minded contractor, he would lose no time in becoming a member of these organizations. Starting from a small local organization in western New York, interest in its object was created throughout the state, resulting in the formation of additional locals and then all united in forming a state association. Observing the broadening influences of this formation, New York state took the initiative of a still broader scope of improvement by the organization of a national body. This has grown to such proportions that to-day it stands among the foremost trade organizations in point of influence, purchasing power and personal standing in the United States. It has brought out ability and executive powers of many men that might have lain hidden in their narrow minds, but for their coming together with their fellow craftsmen. The electrical contractor who wants to enlarge, to keep in touch with conditions and improve his calling, should become allied with these organizations and he would find the money expended to be meagre to the benefits derived."

F. J. Miner, Director for Michigan.



William A. Corrao, Director for Missouri.



Paul H. Jaehnig, Director for New Jersey.

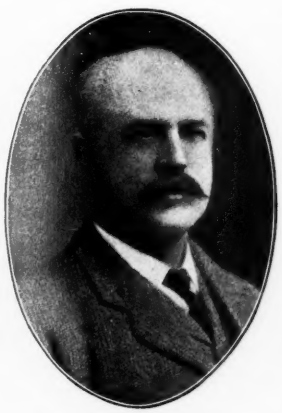
Paul H. Jaehnig, director for New Jersey, writes as follows:

"Of the three classes engaged in the electrical business to-day, the manufacturer, the jobber and the contractor, it seems to me the contractor occupies a peculiar and yet very important position. He stands directly between the producer and consumer, and consequently is a factor in the field that can not be ignored by the other two classes. In other words, the contractor is as essential to the welfare of the manufacturer and jobber as they are to his welfare. Unfortunately, the manufacturer, and more particularly the jobber, have been slow to recognize this fact, with the result that the relations between the three classes are somewhat strained. This should not be so, as there surely must be some common

ground on which these three classes can meet and agree. Each class occupies a position that is well defined, and if each were willing to confine itself exclusively to the limitations of its class, an understanding could be arrived at in short order.

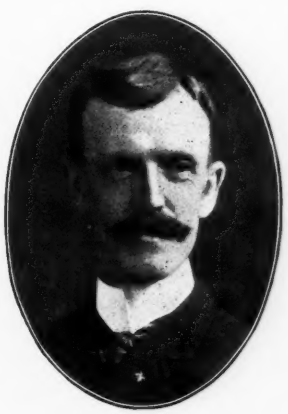
"The keynote of the whole situation is cooperation—the get-together and stand-together idea, for their mutual interests. By a concentration of effort to promote the industry in all its diversified branches, on the part of the three classes, the electrical business will develop beyond our most sanguine expectations.

"Another need of the electrical contractors to-day is to promote sociability among themselves; to have them meet and become acquainted with each other. This is a pressing need, aside from its social features, as by this means they can meet and discuss topics for their common good."



M. L. BARNES, DIRECTOR FOR NEW YORK.

JAMES HILTON, DIRECTOR FOR NEW YORK.



E. M. LAWTON, DIRECTOR FOR OHIO.

J. C. STERNS, SERGEANT-AT-ARMS.

E. M. Lawton, director for Ohio, writes:

"The most prominent idea is that of the contractor's relation to the consumer. The contractor must be recognized as the retailer, and the jobber and the manufacturers must learn this sooner or later. The time is past when the manufacturer is compelled to take his product to the consumer direct. His business should be done with the jobber who is the wholesaler, and by the same line of progression the contractor, as the retailer, should buy from the jobber, and receive protection with the consumer.

"Probably the next important reform should be along the line of commercial credit. In the inception of an electrical industry, the manufacturers and jobbers are oftentimes compelled to lend financial aid to men who have since developed into successful contractors. In no other business have there been such glaring departures on the matter of extension of credit as there have been along this line between the jobber and the retailer. The character and personnel of the contractors are rapidly improving. Instead of being bell-hangers and locksmiths as they largely were in the olden days, they are now largely composed of electrical engineers and practical as well as theoretical men. The necessity for risky credit extension has therefore passed, and the contractors in line with improved relations with the jobber and manufacturers should insist upon a new standard being maintained. But most of all the contractor must understand that only by organization and community of interest these great improvements can be brought about, and those contractors not now associated with a single central body such as the National Electrical Contractors' Association should realize that they are standing in their own light and the light of progress by so doing."

An Investigation of the Steam Turbine.

The following paragraphs, abstracted from the report presented by the committee for the investigation of the steam turbine, W. C. L. Eglin, chairman, at the recent Atlantic City (N. J.) convention of the National Electric Light Association, are interesting as showing the status of this important prime mover at the present time.

A visit was made to the Lynn works of the General Electric Company on Tuesday, April 3. The committee was received by Richard H. Rice, with whom the various features of the Curtis turbine were discussed with particular reference to changes in design from the time of the last visit of the committee to the Lynn works. The committee was shown through the works. The most important feature is the large increase in the number of the smaller sizes of turbines now being built, sizes from twenty-five to 300 kilowatts of the horizontal Curtis type. A number of these turbines were being controlled by a mechanical valve mechanism of a new type, being developed specially for this class of turbine. There was a very noticeable increase in the number of turbines being manufactured in sizes up to 1,500 kilowatts, as well as the smaller types.

The works of the General Electric Company at Schenectady were visited. During the inspection of the works a number of improvements in the mechanical construction were noted. The larger wheels in some cases are being made from steel plates or boiler plates, two plates being bolted to a spider, the spider being placed between the plates and the buckets riveted at the outer edge with the flange of the bucket sections on the inside of the wheel; the two sets of buckets are so arranged that they have a smooth external surface reducing the friction of the wheel.

The committee discussed with the engineers of the General Electric Company, both at Lynn and Schenectady, the various features of the Curtis turbine, and particularly such parts as had required special attention during the past year in regular operation. These were taken up in detail in the report.

The total number of turbines of the Curtis type manufactured by the General Electric Company shipped or on order is 592 units, an aggregate of 580,325 kilowatts. Of these, 385 units are of 500 kilowatts or larger.

The committee visited the works of the Westinghouse Machine Company, Pittsburg, on Friday, April 6, and discussed with Messrs. Sniffin and West the various changes and the progress made in their steam turbine during the past year.

Mr. Sniffin reports that during the past year they have had very successful results from their turbines and he has sent letters to all of the users of their turbines requesting information concerning their

operation. Copies of these letters were sent to the committee, and examination shows that practically very little trouble has developed in the regular operation of the turbines. The Westinghouse company now has in operation 144 units, or a capacity of 122,270 kilowatts. It has shipped or on order 130 units, equivalent in capacity to 200,250 kilowatts, making a total number of 274 units, an equivalent capacity of 322,520 kilowatts.

The most noticeable feature in inspecting the shop was the number of large turbines now being built, and the appearance of the shop indicated that steam turbines were very decidedly the largest percentage of the output of the shop.

The double-flow turbines have been very materially changed in both design and construction. The first stage consists of an impulse wheel with two sets of buckets, steam being admitted through three nozzles, two arranged at the top and one at the bottom of the casing. The steam after leaving the impulse wheel passes on to a series of Parsons blading. After passing through a second stage, assuming that the impulse wheel is the first stage, the steam is divided, continuing in the same direction through the blading, the balance being carried through openings in the cylinder to which the blades are attached to the opposite end to another set of Parsons blading and in this way balancing the thrust. The advantages claimed for this machine are that it obviates the necessity of the use of large balancing pistons and it materially shortens the length and reduces the diameter, making the machine more compact; for these reasons the design particularly lends itself to the larger sizes.

The committee visited the works of the Allis-Chalmers Company, in Milwaukee, Wis., Saturday, April 7, and was received by Messrs. Doran and Rotter, and later met the engineers connected with various departments of the turbines designed by the company. The first visit was to the works of the company at West Allis. In the engine shop a 1,500-kilowatt turbine had been opened up for inspection. The principal difference between this type of turbine and the Parsons turbine is in the mechanical construction, balancing pistons, blading, the governing device, and some other details are given in an appended manufacturer's description.

After a very careful examination of all parts of this machine the committee visited the Reliance works in Milwaukee, where the blading work is done.

Previous to our visit to the works we had examined an Allis-Chalmers turbine at Utica. This turbine had not been in operation for three weeks, and, although cold, was started and full load put on it in less than ten minutes. The load was afterward increased to fifty per cent overload, and the operation was apparently very satisfactory.

I. E. Moultrop, one of the members of the committee, visited Europe early this spring to investigate the turbine experiences in England and on the Continent. His report is appended, together with a brief description of some of the turbine stations visited.

It will be noted in the very large list of turbines now installed that they are being manufactured in large numbers and that three large manufacturing companies are devoting a large part of their works to the manufacture of steam turbines. There are also some other companies engaged in experimental development. These, however, have not reached a point of commercial importance in the larger-sized turbines for us to be able to express any satisfactory opinions.

Mr. Moultrop says in part:

There can be no doubt as to the status of the turbine as a prime mover in the generation of electrical energy by use of steam, for all of the recently designed stations which were visited were equipped with turbines, and some of the older stations, built originally with engine-driven units, are being increased in capacity by the installation of turbine units. The only observed instance in which this is not true is that of the Metropolitan station in Paris, where the station is being completed by the installation of one large engine-driven unit. This station was originally designed for, and about seven-eighths equipped with, engines, and doubtless the design of the station and the local conditions would, in this instance, make the installation of a turbine very inconvenient. It is rather interesting to note that in interviews with the leading engineers no question was ever raised as to the comparative merits of engines and turbines for electric light plants.

The horizontal-shaft type of turbine is practically the only one used, and from the European engineer's viewpoint, it fills their requirements much better than a vertical-shaft machine could possibly do.

The regulation of the turbine is almost invariably accomplished by means of a governor controlling one valve in the steam-supply pipe, the steam being either throttled or admitted in puffs. The majority of the manufacturers use the latter arrangement. None of the manufacturers is attempting to regulate by cutting in or out a series of nozzles and this portion of the turbine construction is therefore very simple and positive. Close regulation is very easily obtained and turbine-driven alternators of different sizes were seen working in parallel; also working in parallel with engine-driven units and apparently without setting up cross-currents sufficient to be at all troublesome.

There seems to have been very little progress made in the matter of steam consumption of turbines during the past year. The best record of economy appears to be that of the Brown-Boveri 5,000-kilowatt machine installed in Frankfort a year or more ago. Apparently, the manufacturers have given more attention in the past year to the matters of standardization and of continuity of service than to economy requirements. Direct-current turbine-driven generators are now being built as large as 2,000 kilowatts which give very good results.

Report on the Peabody (Mass.) Municipal Light Plant.

A report has been presented to the electric light committee of Peabody, Mass., upon the municipal plant of that town. This was prepared by the Electrical Auditing Company, Old South Building, Boston, Mass. The report discusses the present condition of the plant, and suggests two plans for improvement.

The present nominal output of the plant is 600,000 kilowatt-hours per year, while the report is based upon a maximum output of about three times this. To obtain this output and to modernize the plant will require an investment, according to the report, of $56,000 in electrical apparatus at the station. In addition to this there will be required transformers and new lines which will cost $22,000, making a total of $78,000 for the entire remodeling. If such changes are made it is estimated that the cost of power delivered at the switchboard will be 2.29 cents per kilowatt-hour.

If, however, instead of remodeling the plant, the municipal authorities decide to purchase power from outside companies, they could obtain this at 2.13 cents per kilowatt-hour. The municipality would still have to install the transformers and the new lines at an expense of $22,000, but, allowing for this, it is estimated that the actual cost of current generated in a remodeled station would be 2.16 cents per kilowatt-hour, leaving a slight difference still in favor of purchased power.

The report states that the cost of power in the present station is 3.69 cents per kilowatt-hour, a figure agreeing closely with the one reached by the manager of the plant.

The Electrical Plant of the Canadian Niagara Power Company.

By H. W. Buck.[1]

THE plant of the Canadian Niagara Power Company was the first of the power-houses on the Canadian side of the falls to be designed and to have construction work begun upon it. As soon as the decision was made to go ahead with this development the question was raised as to whether the plan should be identical with those of its allied company, the Niagara Falls Power Company, on the American side, or whether engineering advances had taken place since their completion sufficient to justify changes and improvements. In general it was decided to adopt the same system of development, but certain essential changes were introduced:

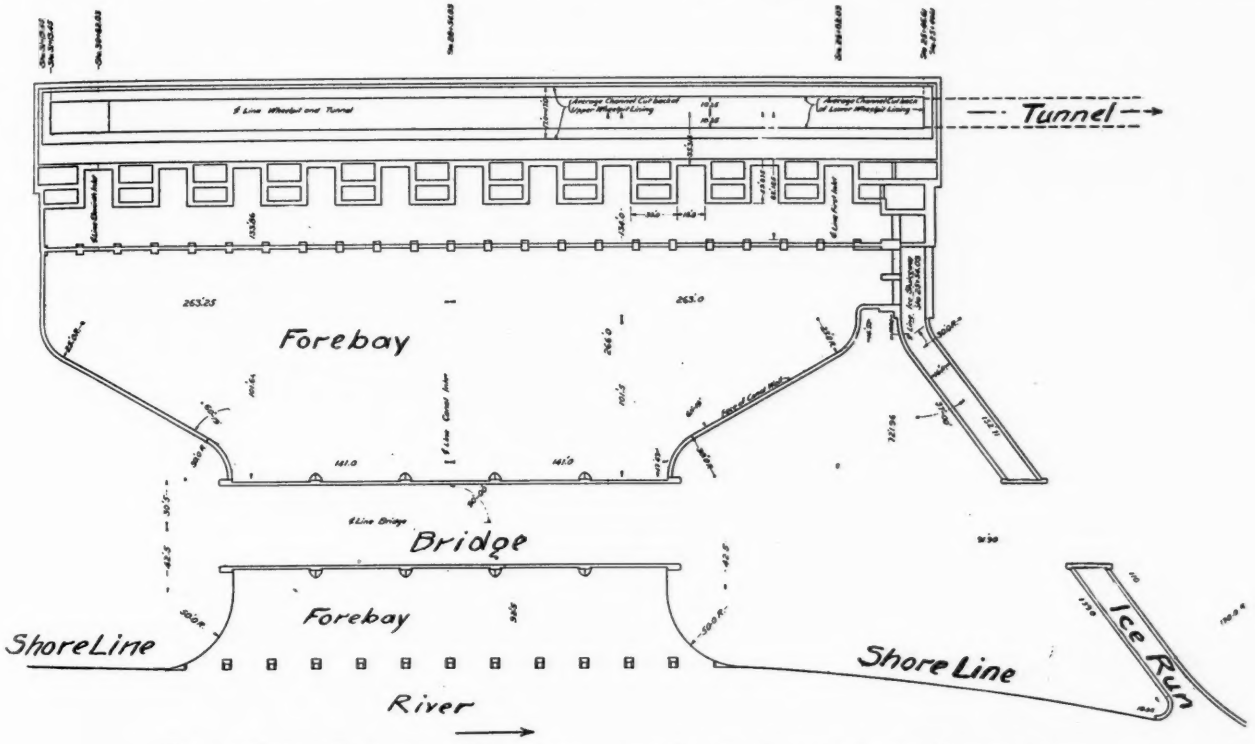


FIG. 1.—GENERAL PLAN OF THE DEVELOPMENT OF THE CANADIAN NIAGARA POWER COMPANY'S PLANT.

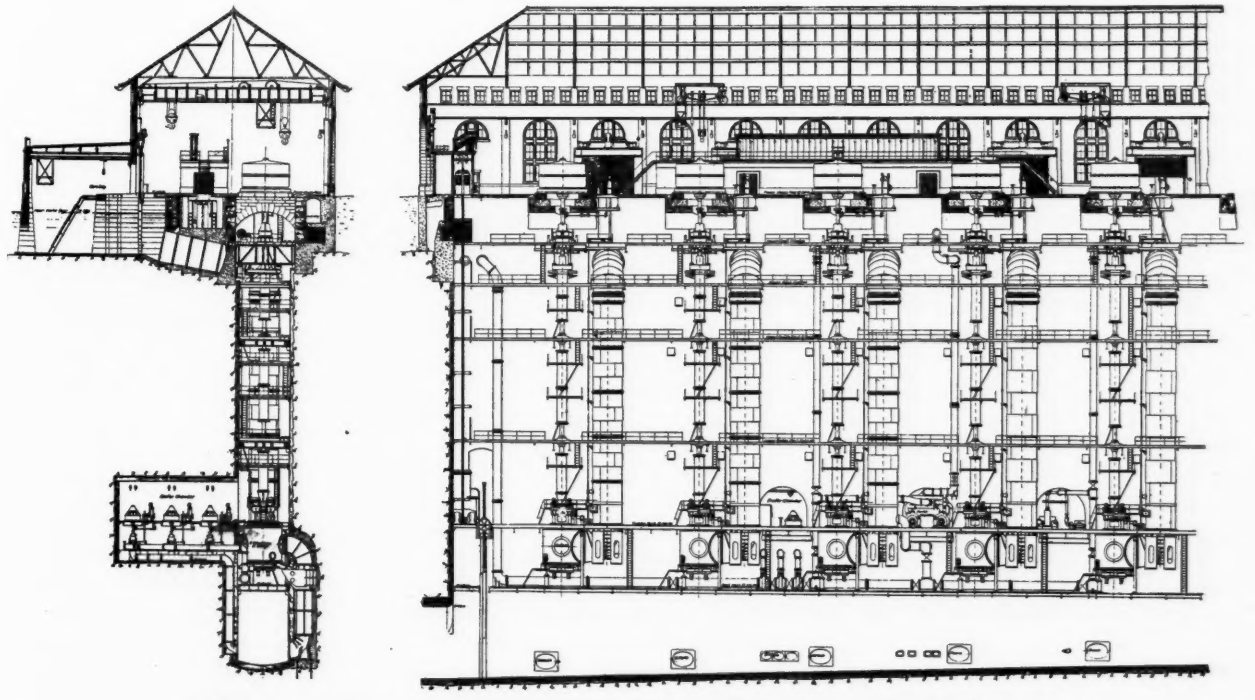


FIG. 2.—SECTIONS OF POWER-HOUSE AND WHEEL PIT, CANADIAN NIAGARA POWER COMPANY.

[1] Paper presented at a meeting of the Canadian Electrical Association, Ontario, June 19, 20, 21.

(1) Generating units of 10,000 horse-power instead of 5,000 horse-power, were adopted.

(2) Generated voltage was raised to 12,000 volts.

(3) Generators were wound for three-phase instead of two-phase.

When the 10,000-horse-power generators were ordered for this development they constituted the record to date for capacity, and were for a short time the "largest in the world," but, like all records in electrical work, it was of short duration. At present there are a number of machines in operation somewhat larger than these in rating, and others are being seriously considered for certain installations which will be nearly twice as large.

It was decided to change from 5,000 horse-power to 10,000 horse-power for the generating units:

(1) To reduce the length of the wheel pit, power-house, forebay, etc., and consequently to reduce their cost of construction.

(2) To reduce the cost per horse-power of the generators, water wheels, etc.

(3 The load of the Niagara Falls Power Company and its ally, the Canadian Niagara Power Company, had become so large that a unit of 10,000 horse-power could be installed without having such unit represent too large a proportion of the total load, from the standpoint of convenience and flexibility of operation.

The decision to have the generators wound for 12,000 volts was made to effect economies in station wiring and in the system of underground distribution necessary to transmit the power from the power-house outside the limits of the Victoria park. The particular voltage of 12,000 was selected as being the highest which at that time was considered reasonably safe for underground service, and also because the Niagara Falls Power Company had already adopted this as a transformed voltage for the transmission of power to some of its local customers.

Three-phase was taken instead of the two-phase winding of the American machines on account of the simplification of switches, wiring, etc., and also to effect the saving of twenty-five per cent in transmission copper.

HYDRAULIC MACHINERY.

The general hydraulic construction of this plant is very similar to that of the American plant, which is too well known to engineers to require detailed description here. Fig. 1 shows a general plan of the development. Fig. 2 shows sections of the power-house and wheel pit, together with their equipment.

The turbines were all designed by Escher, Wyss & Cie., and the first three were built at Zurich. The last two were built from the same designs by the I. P. Morris Company, of Philadelphia. The turbines are of the Francis type, inward discharge, with draft tubes led to the bottom of the wheel pit, as shown in Fig. 2. A regulating gate is installed at the end of the wheel pit to maintain the level of the tail water at a sufficient height at all loads to cover the mouths of the draft tubes. This regulating gate is operated by an eighty-five-horse-power direct-current motor, hand-controlled. The weight of the rotating machinery is carried by an oil thrust bearing under the dynamos, and also by an hydraulic piston at the bottom of the turbine. The turbines give an output of about 12,000 horse-power at full-gate opening at a head of approximately 135 feet.

ELECTRIC GENERATORS.

The generators are of the internal revolving field type with twelve poles giving twenty-five cycles at 250 revolutions per minute. The efficiency at full load is about ninety-eight per cent, and the regulation on full non-inductive load about eight per cent. The generators were built by the General Electric Company, a large part of the assembly work being carried out in the power-house. The armatures are con-

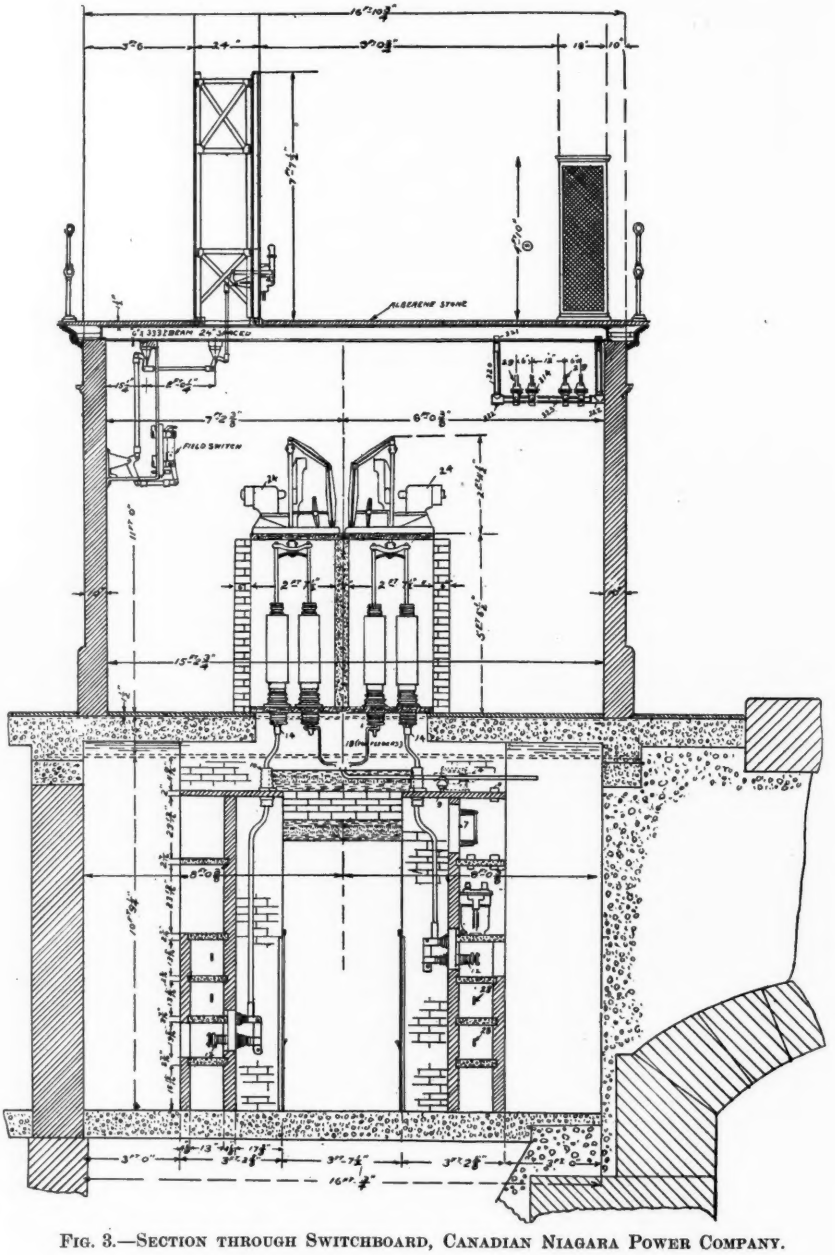


FIG. 3.—SECTION THROUGH SWITCHBOARD, CANADIAN NIAGARA POWER COMPANY.

nected Y, and the neutral is brought out so that it can be grounded if desired.

SWITCHBOARD.

From the generators the current is led through varnished cambric insulated cables to double-throw selector oil switches, and thence to the bus-bars, of which there are four sets. The oil switches are electrically operated by relay switches placed on the main switchboard panels. Fig. 3 shows a general section through the switchboard gallery, and indicates the relation between controlling panels, oil switches, bus-bars, etc. Fig. 4 shows a photograph of the controlling and instrument board. This operating board consists of five generator panels, twenty feeder panels, ten recording wattmeter panels, and three bus-bar interconnecting panels. Each panel is distinct, and contains no instruments or switches except those belonging to the particular feeder or generator in question. In this regard it is different from most of the switchboard arrangements adopted in modern plants. The so-called "bench-board" system of operation usually installed economizes space, but it has certain disadvantages. The concentration of instruments and relays necessitated in this construction may cause considerable confusion at times of emergency. If instrument needles suddenly begin to slam around on their scales it is somewhat difficult to make a prompt and correct association in a bench-board installation between the instruments and the relay switches involved, which are usually on slabs separate from the instruments. With the panel construction adopted in this plant, possibly more space is occupied by the board itself, but operating simplicity and directness results. Each panel contains within its limits all the instruments and switches involved in any operation which the attendant has to make, and consequently there is a minimum liability to confusion and mistake. The separate panel construction also permits the separation of control wires, which become so congested in the bench-board arrangement. In case of an accident in the power-house there is consequently less likelihood of a complete crippling of the control system.

The present equipment of the power-house comprises five machines, and this group and its switchboard is considered as a complete plant. When the power-house structure is extended to its full length six more 10,000-horse-power units will be installed, having an entirely separate switchboard, separate exciter plant, etc. This separation is made for the reason that 50,000 horse-power is believed to be as large a block of power as should be under the control of a single switchboard and its attendant.

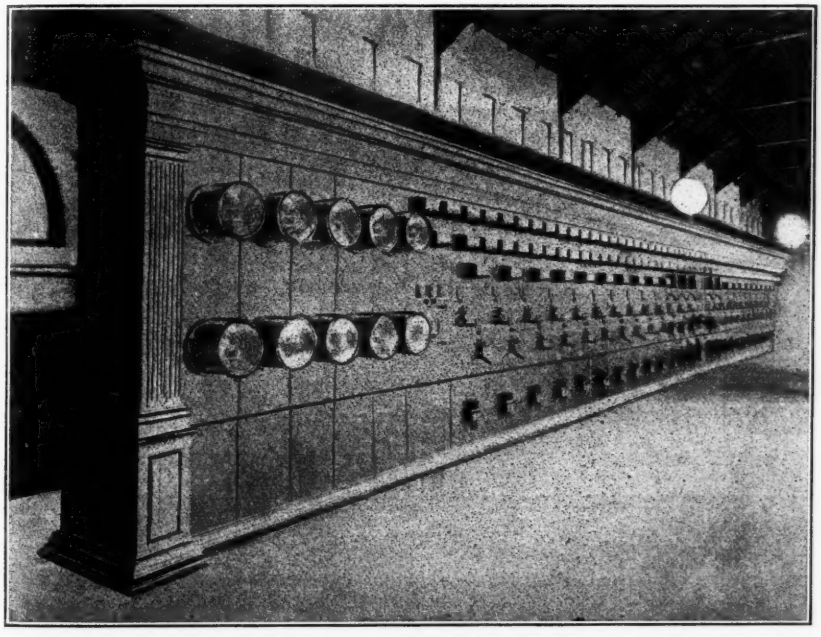


FIG. 4.—CONTROLLING AND INSTRUMENT BOARD, CANADIAN NIAGARA POWER COMPANY.

EXCITER PLANT.

The exciter plant is located in a compartment near the bottom of the wheel pit at the turbine deck level. There are three 200-kilowatt, 125-volt, direct-current generators, each connected to an independent turbine. Any two of these units will carry the entire direct-current load of the power-house. There are two sets of exciter bus-bars, one of which operates the generator fields and the other the direct-current power system, including motors and arc lights. The current is carried up the pit to the main floor of the power-house through a system of vertical copper bars supported every ten feet.

UNDERGROUND CABLE SYSTEM.

All the power from the power-house is transmitted underground by means of 000 B. & S. paper insulated triplex lead covered cables. The feeders are divided into two groups. One set leads from the north end of the power-house through Victoria park and across the arch bridge to the plants of the Niagara Falls Power Company, with which they are interconnected. The other group runs south up the high bank above the power-house to the transformer house there located.

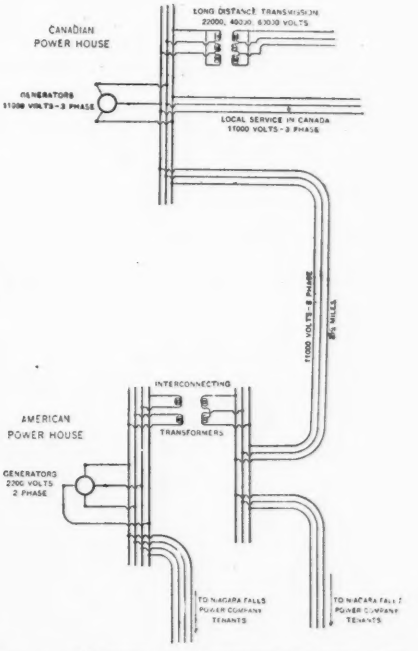

CANADIAN POWER HOUSE
GENERATORS 11000 VOLTS - 3 PHASE
LOCAL SERVICE IN CANADA 11000 VOLTS - 3 PHASE
INTERCONNECTING TRANSFORMERS
AMERICAN POWER HOUSE
GENERATORS 2300 VOLTS 2 PHASE

FIG. 5.—METHOD OF INTERCONNECTING SYSTEMS OF THE CANADIAN NIAGARA POWER COMPANY AND THE NIAGARA FALLS POWER COMPANY.

The conduits are constructed in four groups of eight ducts each. The groups are segregated in order to separate the cables in the manholes, and consequently to reduce to a minimum the risk of damage from short-circuit and also to prevent overheating of the cables in the ducts, the separation of the groups facilitating the conduction of heat in the ground. In no case is the group wider than two ducts, so that every duct has the ground in contact at least on one face. The cables are rated at a maximum of 4,000 horse-power each at 12,000 volts. This rating corresponds to about a forty-degree centigrade rise in copper temperature when all the cables in the group are in service at full

load. The manholes are all made double with a concrete fire wall between the two halves, so that in case of a destructive manhole short-circuit, not more than one-half the feeders could be involved. Fig. 5 shows the method of interconnecting the three-phase, 12,000-volt, Canadian system with the 2,400-volt, two-phase system of the Niagara Falls Power Company through Scott connected transformers. The two systems are constantly in operation in parallel through this connection, and no trouble is experienced from pumping or in controlling the distribution of load.

building is divided into three sections. The east bay contains all the 12,000 switches and bus-bars, the central bay contains only the step-up transformers, and the west bay the 60,000 volt-switching apparatus. The transformers are of the oil type, water cooled. The water supply is insured by a storage standpipe adjacent to the transformer house, which has sufficient capacity to operate the transformers for forty-eight hours in case of a water-works shutdown.

The arrangement of windings on the 1,250-kilowatt transformers is somewhat unusual. The transformers are constructed with five similar coils, two of which constitute one winding and three the other winding, either of which set can be used interchangeably as primary or secondary. By the various combinations of coils, as indicated below, any of the following voltage ratios can be obtained with the full copper efficiency of each coil:

12,000 volts △ to 24,000 volts △
12,000 volts △ to 36,000 volts △
12,000 volts △ to 41,500 volts Y
12,000 volts △ to 62,500 volts Y

The west bay of the building also contains 3,000 horse-power in air-blast transformers, which lower the generated voltage from 12,000 to 2,400 for distribution of power to several small consumers in the city of Niagara Falls, Ont., to whom it would be unsuitable to deliver power at as high a voltage as 12,000 volts. This distribution at 2,400 volts is by an overhead line.

All the high-tension wiring in the transformer house is insulated for the highest voltage, 62,500 volts, and the conductors are of sufficient current-carrying capacity for operation at full output at the lowest transformer voltage, viz.: 24,000 volts.

BUFFALO TRANSMISSION LINE.

The output from this transformer house will be used partially for transmission at 24,000 volts to Fort Erie, and thence across the Niagara river to Buffalo, the distance being about fifteen miles. There are some engineering features connected with this work which may be of interest.

The transmission line is built on a private right of way thirty feet wide extending from the transformer house to the river front at Fort Erie. There will be two pole lines on this right of way each carrying two circuits. The circuits have a nominal rating of 12,500 horse-power each at 24,000 volts, making 50,000 horse-

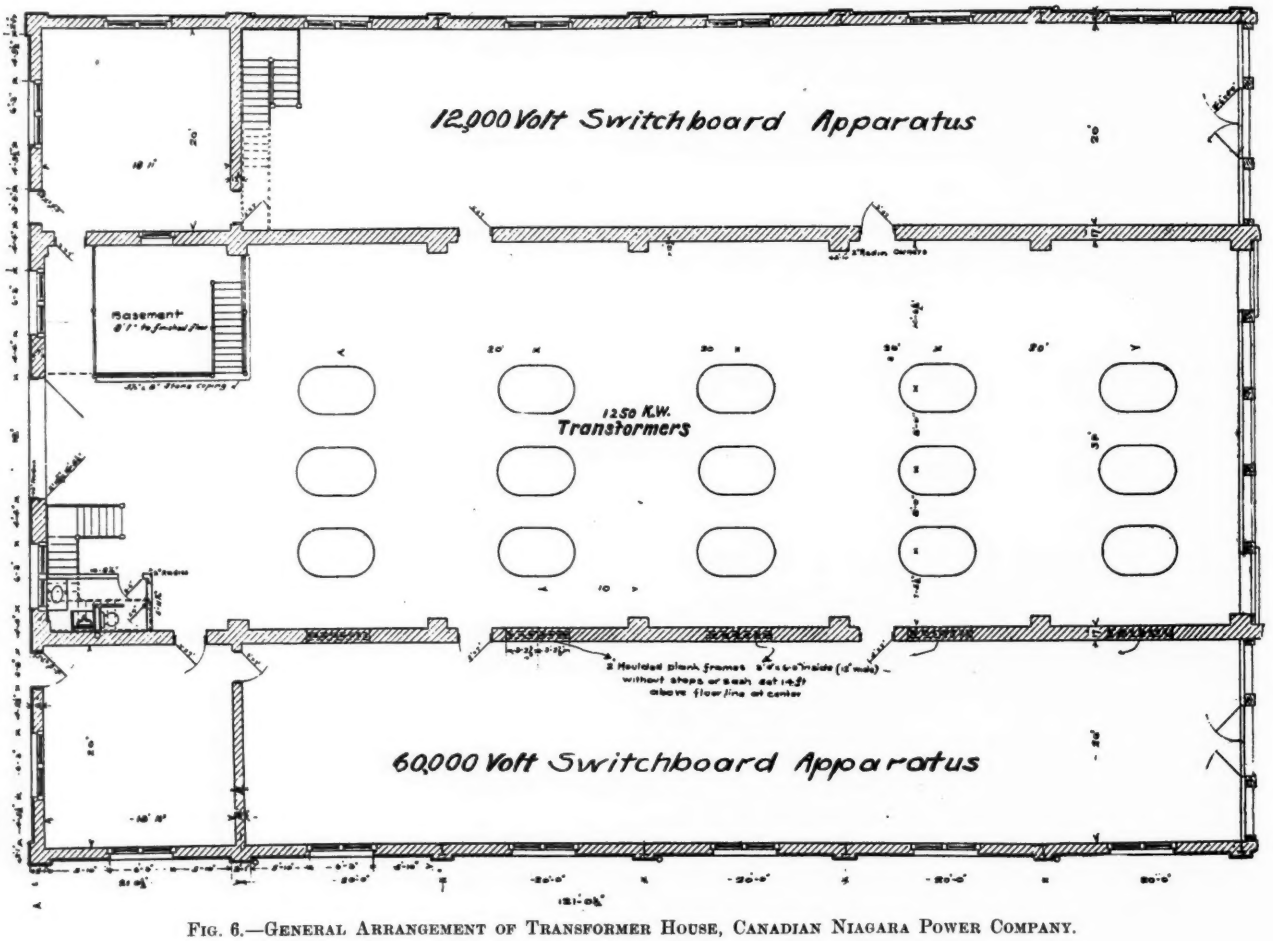


FIG. 6.—GENERAL ARRANGEMENT OF TRANSFORMER HOUSE, CANADIAN NIAGARA POWER COMPANY.

TRANSFORMER HOUSE.

Fig. 6 shows the general arrangement of the transformer house and its equipment. The installation comprises twelve 1,250-kilowatt transformers, each bank therefore requiring one-half the output of a generator at the power-house. Transformers of comparatively small size were installed for reasons of flexibility of operation. The very large transformer units now being used in some plants cost considerably less per kilowatt, but the large size of units makes it difficult to isolate circuits and bus-bar sections so necessary at times in the operation of a plant. The

power total for the transmission. The poles consist of two four-inch wrought-iron pipes jointed together at the centre by a malleable casting which has four struts projecting radially at ninety-degree angles. Truss rods secured at the top and bottom of the poles pass over the ends of these struts, which, when tightened up, stiffen the jointed pipe. The function of this central tubular member is to resist downward compression only. The horizontal stresses on the pole are resisted by four guy rods anchored in the ground with concrete guy stubs. There is one of these guys in each quadrant around the pole. The poles are forty feet in height, and are placed apart at distances ranging from 250 to 300 feet. Fig. 7 shows a map of the transmission line right of way.

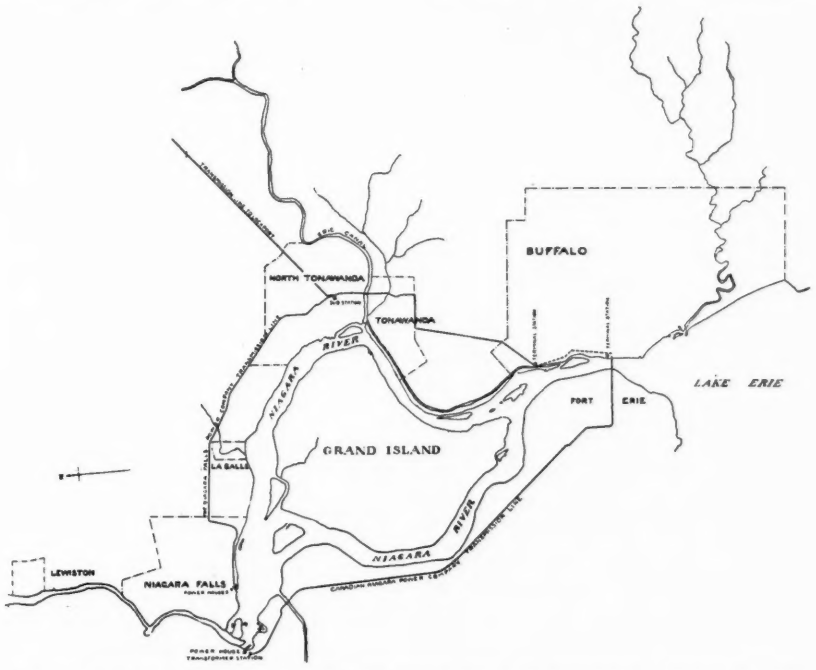


FIG. 7.—MAP OF THE TRANSMISSION LINE RIGHT OF WAY, CANADIAN NIAGARA POWER COMPANY.

The insulators are made of a compound known as "electrose." This material is a very good insulator, is very strong mechanically, and is entirely free from cracks and other defects which are common in glass and porcelain. Similar insulators have been used on the Buffalo transmission lines of the Niagara Falls Power Company for the past three years, and they are the only insulators on those lines which have caused no trouble. It is impossible to shatter electrose insulators by stone throwing, and they will frequently turn a rifle bullet without being damaged seriously. The conductor used on this line is of aluminum of 500,000 circular mils in section and having thirty-seven strands.

At Fort Erie the line is tapped by a connection to a local substation for the supply of power to that municipality. The line then rises from the standard forty-foot elevation to a tower eighty feet high, erected about 4,200 feet from the Canadian shore line of the Niagara river. Thence the line rises again by a single span of 1,200 feet to a tower on the river bank 210 feet in height. Thence by another single span of 2,300 feet the line passes to the Buffalo side of the river to another 210-foot tower. From there it drops down to a new 50,000 horse-power terminal house constructed for the distribution of this power in Buffalo.

For this long span crossing, 500,000 circular mils, sixty-one-strand aluminum cable is used. Each wire is secured to the top of one pole to an insulated support. At the towers the lines are attached through strain insulators to steel cables, which pass sheaves about twenty-four inches in diameter, and thence to weights which are equal to the tension on the wire in pounds. This amounts to 4,500 pounds on each line. The live portion of the line passes down the tower from the outside of the strain insulator to the terminal house on the Buffalo side and to the main transmission line on the Canadian side.

The power-house has been in successful operation for about a year, and five generators are now in service. The transmission lines to Fort Erie and Buffalo are now in process of construction, and are expected to be put in service about November 1.

The Faraday Society.

The twenty-first ordinary meeting of the Faraday Society was held on Tuesday, June 12, when a paper on "The Electrolytic Deposition of Zinc, Using Rotating Electrodes," by Dr. T. Slater Price and Mr. G. H. B. Judge, was communicated by Dr. F. Mollwo Perkin.

An improved form of apparatus for the electrolytic deposition of metals using a rotating cathode is described. The ordinary beaker is replaced by a tap funnel of about 100 cubic centimetre capacity, so that the electrolyte can be run off at the end of the experiment, thus obviating the use of a siphon. Use is made of a bicycle hub for rotating the cathode.

In the deposition of zinc from a pure solution of the sulphate, no extraneous electrolyte being added, with a current of two amperes (cylindrical cathode of gauze, twenty-two millimetres in diameter and forty millimetres long) and voltage 4.5-5.5, the results are uniformly low. The error increases with higher currents, and is due to the heating effect of the current. On keeping the electrolyte cool by means of an ice jacket good results are obtained, even in the presence of free sulphuric acid, provided that the concentration of the latter does not exceed a certain amount (about $\frac{n}{6}$).

It is further shown that zinc can be quantitatively deposited from solutions of zinc sulphate, containing 0.2274 gramme zinc in the presence of two to three grammes sodium sulphate. The deposit is better than that obtained by the usual method, using sodium acetate and acetic acid; it is not necessary to cool the electrolyte.

An improvement of the method of Kolloch and Smith (*Journal of the American Chemical Society*, 1905, 27, 1,255), using a rotating anode and mercury cathode is also described. It is found necessary not to have present more than two drops (40 drops = 3 cubic centimetres) of free sulphuric acid in order to obtain quantitative results in the estimation of zinc.

Dr. F. Mollwo Perkin described "A Simple Form of Rotating Cathode for Electrochemical Analysis."

The cathode consists of a spiral of platinum wire, or, better, iridio-platinum wire. Nickel wire may be substituted for platinum, and the author recommends its employment in place of the more expensive metal. Attention is also drawn to the

solubility of platinum anodes, with heavy currents 0.0016 gramme being dissolved in a cyanide solution in thirty-five minutes.

Mr. S. Binning and Dr. F. Mollwo Perkin read a paper on "The Electrolysis of Solutions of Thiocyanates in Pyridine and in Acetone."

On oxidation of thiocyanates with chlorine, persulphates, etc., a yellow coloring matter—canarine—is obtained. By electrolysis of aqueous acidified solutions of thiocyanates an apparently similar product, which was originally described in 1884 by Lurdow, is obtained. The authors consider that this substance is not identical with the canarine obtained by chemical means, because it shows certain reactions not given by the oxidation product. They find that in alkaline solutions no coloring matter is produced, but that cyanides are apparently formed. A difficulty met with in the electrolysis was the formation of the coloring matter on the anode surface, which caused a great resistance to the passage of the current. The difficulty was got over by using a lead cathode on which bristles had been fixed. This was rapidly rotated within a cylindrical platinum anode, the bristles cleaning the anode surface as the cathode rotated. With a current of five amperes (ten amperes per square decimetre) the electromotive force was five volts.

Anhydrous ammonium thiocyanate readily dissolves in dry acetone and pyridine, in either case there being no difficulty in obtaining a twenty per cent solution. These solutions readily conduct the electric current. In the case of the acetone solution with a current of 1.5 amperes (three amperes per square decimetre) the electromotive force required is 6.7 volts. With pyridine for the same current it is about nine volts. In the case of the acetone solution a yellow amorphous powder separates out. With the pyridine solution the liquid becomes orange-red, but no precipitate is produced. On pouring this orange solution into a large excess of water an orange precipitate falls out. These two substances are certainly not identical with the canarine obtained by oxidation; at present the authors are unable to say whether the product obtained from acetone is the same as that produced from pyridine. It is found that when a lead anode is employed in the pyridine solution it goes into solution; lead thiocyanate is produced and metallic lead is deposited at the cathode.

ECONOMICAL LUBRICATION OF LARGE POWER PLANTS.[1]

BY W. M. DAVIS.

In the lubrication of a large plant the first consideration is, of course, efficiency, then economy, although some engineers seem to think that it is impossible to attain the first and at the same time give any consideration to the latter. To obtain efficient lubrication the first thing to do is to see that the lubricants used are of good quality, either choosing well-known or tested brands, or specifying what they shall be composed of and the test that they shall conform to. Next is to see that suitable and reliable appliances are used to feed the oils, that crank pins, eccentrics, bearings, etc., be provided with centre oilers, telescope oilers, sight-feed cups, or other devices, so that every drop of oil that is fed from the cups will go directly to the bearing surface, without any being thrown or spattered over the engines or machinery.

For slow-speed engines ordinary sight-feed cups, properly looked after, will give satisfactory results, but for heavy high-speed work the continuous oiling system with the oil flowing from an overhead tank to the bearings, in streams if necessary, thence through a filter and back to the overhead tank, is the most efficient method of lubrication. From an economic standpoint, the success of such a system will depend entirely upon the means provided to catch the oil after it leaves the bearings.

With slow-speed engines, and, in fact, with all machinery that uses oil in quantities, every bearing on which oil is used should be provided with substantial sheet-steel pans, arranged, if possible, to drain the oil to some central point, into a bucket or tank, from which it can be taken to the filter. When the crank case is enclosed, care should be taken to keep the oil as free from water as possible, as water will sometimes travel along the piston rod into the crank case, and, if it is the least bit alkaline, form compounds used in the boilers; the oil and water together will sometimes form a compound which is hard to separate, and which lowers the quality of the oil.

On slow-running engines, where the pressure is not excessive, and on some slow-running shafting, a good grade of grease or tallow compound will often give good results, but where the compression cups are used the grease should be quite soft, so that it will spread freely. If too hard, great pressure will be required to feed it, and it will also tend to increase the friction load.

In regard to cylinder lubrication, no one can make any hard-and-fast rule as to the proper amount of cylinder oil that should be used; that will have to be determined by test and experiment. First, a good quality of oil should be provided. Second, to get economical results, make the conditions as favorable as possible. See that the steam is dry; do not carry the water in the boilers too high; do not use an excess of strong alkaline boiler compound and, above all, do not set the piston rings out too tight. Before putting the rings in the piston, chamfer the edges off slightly with a file. If the edges are sharp they will tend to scrape the oil off the surfaces. Where the engine speed is constant there is little choice between a force-feed pump and an ordinary sight-feed lubricator. Either will give sufficient and economical service if properly taken care of; but where the work is intermittent, the engines stopping and starting, as is the case with mining engines, tugboats, etc., the force-feed pump is the more economical.

To determine the proper amount of cylinder oil to use in any particular engine, first have the conditions as favorable as possible. Then gradually reduce the oil feed and note the action of the valves. If they work smoothly it is a good indication that the cylinder is all right; but if they commence to groan increase the oil feed slightly. In this way the minimum amount of oil that should be fed can be determined very closely. After this the cylinder head should be removed and the surface of the cylinder examined. If it looks oily and, when wiped over with a piece of soft paper, a stain is left on the paper, it is certain that enough oil has been fed.

Another important matter in economical lubrication is in the receiving, handling and proper distribution of the lubricants. If the plant is a large one the oil house should be provided with storage tanks of sufficient size to hold a tank car of each kind of oil. By purchasing the oil in tank cars there is a reduction in the price per gallon and a saving in the labor of handling of the oil and the empty barrels. In a small plant where only a few barrels of each kind of oil are used a month, tanks holding from two to ten barrels should be provided, so arranged that the oil can flow by gravity from the barrels into the tanks. Care should be taken to see that the barrels drain out clean.

[1] Abstract of a paper read recently before the Institution of Mechanical Engineers of Great Britain.

Electrical Notes from Europe.

(By Our Special Correspondent.)

THE French Thomson-Houston Company has been making a series of tests in the suburbs of Paris with a single-phase system for tramways. Alternating-current is furnished from a motor-generator set working upon 500 volts direct-current, and it is coupled to an alternator giving 500 volts and twenty-five cycles. An experimental trolley line takes this current, and the cars, which are of the same type as is used within the city, are run back and forth over a short section of track. On the cars are mounted two Latour motors of the four-pole type designed for fifty horse-power each, working at 300 volts, single-phase current. Owing to the municipal regulations a higher voltage than 500 could not be used on the trolley wire. A transformer placed under the car-body lowers the voltage from 500 to 300 volts. The secondary has a number of terminals, so as to allow the use of a controller for varying the voltage on the motor. So far the tests have been very satisfactory. The air-gap of the motors, which is two millimetres at present, could be increased if desired, and it is found that the motors can start up with three times their normal couple, corresponding to 150 horse-power.

In a paper read before a recent conference, M. Rene Koechlin, a well-known engineer, exposed his project for securing a large amount of water power from the Rhine, upon the position which lies between Bale and Brisach. Here the river has a rock bottom, and M. Koechlin gave the details of a dam which could be erected to the best advantage. From the dam leads an intake canal of some size, to a distance of four miles or more. The canal is 100 feet wide and fifteen feet deep. At the end of the canal he proposes to erect a large turbine station which will utilize a head of water varying from twenty to thirty feet, with a large volume of water. Under these conditions the plant would deliver 35,000 horse-power and would contain twelve turbines of 3,000 horse-power each working at low-pressure, coupled to three-phase alternators. Transformers would raise the voltage to 10,000 volts for the overhead line. Should the station be overloaded, it is proposed to erect a second hydraulic plant in the neighborhood, having about the same capacity.

The Oerlikon company has been making experiments on the high-tension single-phase system for electric locomotives over a section of line from Seelbach to Affoltern or about two miles in length. Two different forms of locomotive are used. In the first locomotive is mounted a rotary set for converting the current so as to use direct current on the motors. An induction motor takes 15,000 volts current at fifty cycles from the trolley wire. It is coupled to a generator and the latter supplies the motor circuits through the controller. On the axles are mounted two motors of 200 horse-power, making a total of 400 horse-power for the locomotive. The total weight is about fifty tons for the first locomotive. On the second locomotive the line current is first lowered by two transformers to 750 volts and is then sent into two specially designed motors using single-phase current and mounted in series. Each motor is rated at 200 horse-power, and the locomotive weighs forty-five tons. Different forms of trolley are used in the experiments and also various methods of suspending the wire. So far the results have been generally favorable, and the trains have made about 2,000 trips over the experimental section.

That direct-current at high-tension on the constant-current system can be used successfully for long-distance transmission of power has been well proved by the St. Maurice—Lausanne and other important plants in Switzerland which have been designed on the Thury system. According to the recent tests made at Geneva by the same company, we may expect some sensational developments in regard to the direct-current system. It is claimed that it can use two or three times the highest voltages which are allowed for the alternating-current upon overhead lines. Should this prove to be true, we will find the distance to which current can be transmitted greatly increased. Experiments with new apparatus have been made in the presence of leading engineers from different parts of Europe. According to reports, it appears that as high a voltage as 100,000 has been used between the line and earth, which is equivalent to 200,000 volts between two wires. As we are now limited to 60,000 volts or even less than this for alternating-current, the experiments are of great practical interest.

Among the most extensive electrical enterprises in France must be ranked the electric tramway system which has been recently completed in the Mediterranean region. It covers a continuous length of thirty miles and runs between Cagnes and Menton, passing by Nice and Monte Carlo. Great difficulty was experienced in laying the road-bed, as the road runs along the Corniche route overhanging the sea, and this route had to be enlarged considerably in many places, tunnels cut in the rock, etc., which took a large amount of work. The road is one metre (39.3-inch) gauge, and was partly in single and partly in double track. It uses a Broca rail weighing 100 pounds per yard. The rolling stock consists of 106 motor cars of two axles and two motors each, forty-two trailers and three hauling cars. There are also twenty-two freight cars in use on the line. Between Nice and Monte Carlo, owing to the narrow way and sharp turns, a form of double motor car is employed which consists of two short cars coupled together. The usual form of overhead trolley system is employed, with metal poles and brackets. Current at 550 volts is supplied from six substations along the route, which receive 10,000 volts alternating-current from a hydraulic plant. In the Sainte-Agathe substation, which may be taken as an example, have been placed two motor-generator sets of 250 kilowatts each, a battery of 281 Union cells and a booster group of thirty-five kilowatts. The freight traffic on the new lines promises to be considerable. The system has been installed throughout by the French Thomson-Houston Company and the Société de l'Energie Electrique.

Among the aerial telegraphy projects we may mention the great station which is to be erected in Germany at Nauen by the German Aerial Telegraph Company on the Telefunken system. The new plant will differ considerably from the recently erected stations, seeing that it is to consist of a single high tower, instead of the four-tower form such as is used in the government plant at Norddeich and also at Oberschöneweide, near Berlin. At the Nauen plant the tower is to have a set of wires running down to the ground and forming a sort of screen for sending and receiving the waves. This form of construction is less expensive to set up, although it may not be as powerful as the funnel-shaped construction which is used in some cases. The height of the tower is to be nearly 300 feet from the ground and it is expected to cover a distance of 1,000

miles, so that it can signal to most of the leading points on the Continent. At Paris the experiments which have been made on the Eiffel tower for some time past have given good results, and the military authorities are now taking measures to use the tower as a centre of operation for signaling between Paris and the different fortified places to the east and west. Signals have been sent to Belfort for some time past, and there is no doubt that the proposed system will prove of great value in military operations.

Walter Wellman's great airship with which he expects to reach the North Pole has recently been finished at the Louis Godard establishment at Paris and is now making a series of trials at the headquarters of the expedition at Spitzbergen. One of the novel points will be the use of a wireless telegraph apparatus which will be mounted in the basket cabin on the deck of the airship, and will use the steel guide rope trailing on the ice as a mast-wire. Signals will be sent in this way to Hammerfest, and thus the news of the expedition will always arrive. This will prove a most valuable aid to the expedition. The Norwegian government, in the person of the minister of public works is now engaged in erecting the stations at Spitzbergen and Hammerfest for this purpose. Major Hersey who represents the United States weather bureau in the expedition, has been at Spitzbergen for some time in the interests of the party.

The Canton of Zurich proposes to erect a large hydroelectric plant in the valley of the Albula, and the station is to be fitted with machines to the extent of 20,000 horse-power. It is said that the plant is to cost $2,000,000 to erect. From the dam will run a canal four miles in length, ending in a circular water chamber cut out of the rock. From here will leave two penstocks of six feet diameter running down to the turbine station. The latter is to contain eight turbine and dynamo units of 2,500 horse-power each. It has not been decided as to what kind of current will be used. It is proposed to use three-phase current with 70,000 volts on the line, or direct current with 79,000 volts between the poles, with a grounded neutral wire, making 39,000 volts between a wire and ground. In either case the overhead line will be double, and will run upon beton poles, using metallic towers in a few cases. The overhead line will have switching apparatus for dividing it into sections every twelve miles.

Different methods of melting glass by the electric arc have been proposed. One disadvantage coming from the use of the arc is that small particles of carbon are apt to enter the glass, especially when a long arc is used. Mixing oxydizing substances with the glass may help to overcome this, but not altogether. On the other hand no success has been obtained by using metal electrodes instead of carbon. The method of blowing the arc over the glass is not to be recommended, as it only heats it in spots. In order to melt a pound of glass we need from two to three kilowatt-hours for the arc. It has lately been proposed to use cryptol for heating the glass. The crucible containing the glass is placed in a mass of cryptol. Current comes from a carbon plate at the lower part of the cryptol and goes to a carbon rod or series of rods placed in it. The resistance of the mass is changed by raising or lowering the rods. Fusion of the glass is easily obtained in this way, seeing that it is much lower than the heat of the arc. A current of 100 volts was used in the above tests, and it seems that this method may have some value.

Tests upon windmills for producing current have been carried out for the Danish government by Professor La Cour at Askow, with very good results. With a four-wing wheel, which he finds to be the best form, using fifteen square yards surface, and a wind of twenty feet per second we obtain two horse-power. A wind-speed of thirty-five feet per second gives about ten horse-power. In order to provide a reserve during an absence of wind he finds that a small petrol motor which can be coupled to the dynamo is the best to use, as it costs much less than a storage battery. At Askow he has been running a windmill plant which fed 450 incandescent lamps, with some arcs and motors. Such a plant costs $4,700 to erect, including the price of the ground, and it costs $165 per year to operate it. A plant of this kind would be very good for farm use, and a much smaller one would answer in many cases, costing in the neighborhood of $1,000. A number of windmill electric plants of this kind are now running in Denmark.

It is proposed to electrify a number of the Italian railroad lines which end at Novara in the northern part of the country, which are now operated by steam, and to this end the railroad department has lately requested the minister of public works to arrange for constructing a hydraulic plant for securing the necessary current. This can be done by using the water of the Lessin, and it is stated that a 7,500-kilowatt hydroelectric station will be erected. From the large dam which will be placed across the river, will lead a canal of some twelve miles length running to the turbine house. The same canal will be utilized in order to furnish a large supply of water for the already existing Cavour canal. The latter is used for irrigation, but at present it is desired to increase its supply. It will cost about $3,000,000 to construct the canal. At the same time the Italian government has been occupied with the question of the use of electric locomotives for the Simplon, as concerns the portion lying outside the tunnel on Italian ground and running from Domo D'Ossola to Iselle. This portion of the track along with the line inside the tunnel and the part lying on Swiss territory will be electrified and as soon as the three locomotives are delivered from Switzerland we may see the new line running.

Finland is a country in which electrical affairs are commencing to be developed, and already a number of large orders have been given to the leading electrical firms for apparatus of various kinds. A number of new electric plants are now in project in this country. Among the most important of these is the proposed plant which the municipality of Helsingfors has recently decided to erect for supplying light and power to the city. The estimated cost of the plant is near $500,000, and a credit has already been voted for the purpose. As it is proposed to utilize some of the large falls which are found in the country for erecting hydroelectric plants there will no doubt be considerable activity in electrical matters. It is likely that electric traction will be applied upon many of the railroads, as this question has already been taken up by the government, which controls all the lines. Reports state that a large amount of capital is to be devoted for this purpose.

In Switzerland some of the army corps have been making tests upon the use of a portable high-power arc projector for field use, and it seems to answer all the requirements. The Cuenod firm, of Geneva, has built this apparatus. The projector is mounted on an automobile chassis and is about three feet in diameter. The automobile makes a speed of five to ten miles an hour, and is fitted with a dynamo coupled on the shaft of a gasolene motor. By means of a new system, a cable connected with the projector allows it to be maneuvered from a distance of 600 feet.

and thus it may be put out of reach of the enemy's fire.

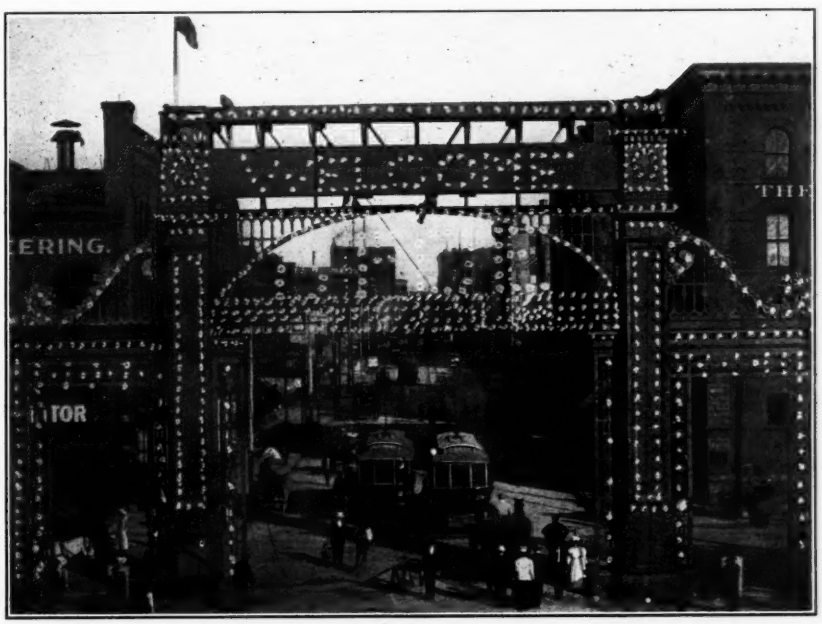
A large company has been formed at Christiania for operating the new Birkeland and Eyde process for obtaining nitrogen from the atmosphere. It is said to be capitalized at $2,000,000, part of which is furnished by German and French banking houses. The process consists of treating air by means of the electric arc and so taking out the nitrogen in a fixed or a combined state, especially in the form of nitrates, and the latter will replace the Chile nitrates and others. At Nottoden has been erected a large plant which uses three of the Birkeland apparatus working with powerful arcs; each of these units takes about 700 horse-power to run it. The arcs are contained in a set of stone towers or furnaces in which the nitrous gases are transformed into nitric acid or are combined so as to form nitrate of lime. In the three apparatus they are able to treat some 3,000 cubic feet of air per minute. Not long ago the capitalists who were interested in the process sent a committee of experts to examine the plant and they made a very favorable report on the same, which led to the formation of the present company. It is expected to use a large amount of hydraulic power in the future especially for the production of nitrate of potash.

It is estimated that the total amount of hydraulic power which is obtained from the falls in Switzerland for running electric plants is now more than 225,000 horsepower. Of this amount we find forty per cent used for electric lighting, thirteen per cent for traction, twenty-three per cent for electrolytic work and twenty-four per cent for motors. Notwithstanding the great amount of power which the electric plants furnish, Switzerland was obliged to import as much as $11,000,000 of foreign coal during the period from 1898 to 1904. In view of this it has been desired to utilize a number of new falls so as to obtain a large amount of electric power. Thus a new plant for which a concession has been obtained in the Bernese Oberland is expected to yield 40,000 horse-power. The Canton of Berne is interested in this project. Seeing that the railroads will need as much as 150,000 horse-power, still other plants will no doubt be erected. A concession has already been obtained for a large hydroelectric plant on the Rhine near Numpf, which will afford a 230-foot head of water. A canal fifteen miles long will run from the dam to the turbine station.

The Italian government proposes to assume control of all the telephone lines in the country in the future, and to this end the minister of posts and telegraphs and telephones is making arrangements to have the new telephone systems erected by the state, as well as to take over the lines which private companies are now operating. A project is on foot at present for carrying this out in the best manner, and it is proposed to indemnify the companies owning the lines by means of a series of annual payments which will continue up to the time when the concession ends. It is expected that the telephone receipts will be sufficient to cover this expense and at the same time allow the state to operate the lines, so that no additional expense will be required for this purpose. The leading telephone companies seem to be disposed to make such an agreement; among these are the Italian Telephone Company and the North Italian Telephone Company. This would give the state control of twenty-four urban systems, among these being Rome, Florence, Naples, Venice, Milan, Lurin, etc., and including most of the large cities, as well as fifteen interurban lines.

C. L. DURAND.

Paris, June 30.



ELECTRICALLY ILLUMINATED ARCH, DENVER, COL.

The Denver "Welcome" Arch.

Denver will have a most elaborate permanent electrical display in the welcome arch now being built in that city. The arch which is now in course of construction spans the street directly in front of the entrance to the Union depot and will be covered with 400 incandescent lights. The sign "welcome" will blaze out to every visitor who steps within the gates of the city.

Denver is aggressive in its advertising. It will take up anything that has the earmarks of success—of getting business. The opinion is firmly rooted and citizens back it with firm convictions that if you push your city you push your own interests. When the Denver Gas and Electric Company began a most spirited campaign in favor of display lighting for advertising purposes a number of years ago, it met with a cordial welcome. The business men found that lighting increased their business. They also found that the general scheme of lighting added to the already numerous attractive features of their city. All of a sudden Denver bloomed in the lead as a splendidly lighted city and became known as "The City of Lights." That reputation was well worth sustaining, the citizens reasoned, and the slogan went up "Boost for the City of Lights." In no time every dark corner in the business section was turned into a flood of light and there was a ready response to any suggestion that would improve the general lighting of the city both commercial and public.

It was suggested that a welcome arch which would express the hospitality of Denver's citizens be erected at the entrance to the Union depot. The suggestion resolved itself into a subscription of $13,000 for this purpose. Divers interests and individuals gladly contributed this amount of money. The arch will be lighted for the first time on the occasion of the Elks' convention which will be held in Denver July 16.

ELECTRICITY: THE POWER BEHIND THE SOUTH.[1]

BY W. S. LEE, JR.

If we should examine a railroad and industrial map of the South made fifty years ago, we should find, located along the ridges, very few and short railroads. We should also find situated along streams a few cotton, woolen and other factories. In almost every case the articles manufactured were for local consumption and were furnished to the various large farms or plantations situated in the immediate vicinity.

As railroad construction began rapidly to increase in the South, the tonnage of these small factories was not considered sufficient inducement for the location of railroad lines along the valleys. Consequently, these locations were made on ridges or plateaus which afforded cheaper construction.

For many years the revenue of the railroads was derived almost entirely from transportation of agricultural products, but within the past fifteen years the South suddenly became a manufacturing as well as an agricultural section.

The rapid development of manufacturing in the South naturally caused manufacturers to seek some mode of transportation, and as a result the factories were located along the established lines of the railroads.

On the other hand, if we should examine railroad and industrial maps of New England for the same time we should find the condition reversed. New England having been a manufacturing country before the advent of railways, its water powers were developed and factories located along the valleys. Consequently, when railroads were built in New England they were forced to follow the valleys, as the freight on the factory products furnished the principal source of revenue. As a result, New England had the advantage of cheap motive power while the South struggled along with the more expensive.

It is true that a few water powers were developed for mill work, but being located away from the railroad, experience showed that these mills, although having cheap power, were at a great disadvantage, owing to the lack of transportation facilities, in competing with mills located on railroads.

Our engineers saw that it was necessary to bring the power interests and the railroad interests together, and have been wrestling with this problem since the beginning of the manufacturing era. The railroads could not be moved from the ridges to the valleys, neither did the business warrant the expenditure necessary to build another system of railroads along the streams. The alternating-current generator and transformer came to their assistance and opened up the way. By the generation of electrical power on our streams, and its easy transmission over long distance by wire, cheap power with good railroad facilities can be placed at the disposal of every manufacturer. While our progress has been greatly delayed on account of these topographical and railroad conditions, we are to-day in a position to derive more benefit from our resources, in many cases, than if our streams had been developed in the days of direct drive. The manufacturer is able to locate factories on high ground, thus obtaining the advantages of better light, healthier and more convenient surroundings, while if the direct drive were used factories would have to be placed in valleys near water powers, where they would be in many cases cramped for room and oftentimes located on unhealthy ground.

The solution of the problem of transportation and power interests immediately created a prosperous condition in the South. Our agricultural and manufacturing and agricultural statistics show that we are not only large producers of raw cotton, but that we are fast becoming a cotton-manufacturing centre of the world. This gratifying advance in Southern wealth, since the beginning of this century, is immediately connected with the betterment of the cotton situation. This wealth, as shown by increased assessment of property, amounts to over one and one-third billion dollars.

Considering that the valuation of the cotton crop for 1904-1905 amounted to six hundred and eighty-five million dollars, that is, the cotton crop is worth more than one-half the value of all the other crops, we see that something like forty per cent of this one and one-third billion of increased valuation is due to our increased cotton crop. But of the 13,566,000 bales that the South has grown, our spinners have taken 2,116,318 bales against 2,193,937 bales taken by the Northern spinners. Considering the fact that ten years ago the Southern mills consumed less than half as much as the Northern mills, it is very encouraging to note that we are almost on a par with the North, and the advantages which the South possesses are good reasons for believing that the South will, in a very short time, be spinning the greater part of its cotton crop instead of sending it to the North and abroad for manufacture.

The advantages of the South as a cotton-manufacturing centre are summed up as follows:

1. Mills located in the South are enabled to secure their raw material almost at their doors, and it will be many years before any state manufactures as much cotton as it produces. This, of course, reduces freight rates to a minimum.

2. The various railway and steamship lines radiating to every part of the world enable the Southern mills to offer their goods in all markets. The completion of the Panama canal will afford still further advantages in transporting our goods to the Orient.

3. Although help has been somewhat scarce, due to the very rapid development of mills, nevertheless, the South is building yearly a great number of mills and securing help for same. The help of the South is fast becoming more expert, consequently, the same number of hands are annually producing more goods. The healthy location of the cotton districts of the South is drawing more and better help into the cotton mill district every year.

4. The South's greatest asset and advantage consists in its numerous water powers situated throughout the cotton-producing and cotton-manufacturing district. The South has something like two million horse-power still to be developed in the very heart of the cotton field, and in a climate where ice can not materially affect this development.

It seems strange that this enormous power should have lain dormant in the midst of our factories while they were producing power by steam at a great cost. It would seem that the energy of these water powers was destined to lie dormant until conditions arose in which all factors would work in unison for maximum advantage and that the South would then proclaim that it had become the manufacturer of cotton goods for the world.

The advantages of the electric drive in cotton manufacture were explained as follows:

With an electric drive a meter can be placed in the circuit, supplying power to any machine or set of machines and the instantaneous power, or total power for any given time measured. This may not at first sight seem to be of such great importance, but after due consideration the manufacturer will note that one of the greatest problems before him to-day is how to obtain exact and definite knowl-

[1] Abstract of an address delivered before the American Cotton Manufacturers Association, Asheville, N. C., May 16.

edge of the cost of production. Keen competition requires that each operation in manufacturing be figured to a certainty in order that every means may be taken to reduce the cost of production. To illustrate the importance of this question of measuring the power necessary for driving any machine, we note an instance that came under our observation some time ago. One of our engineers was called upon to explain why a certain seventy-five-horse-power motor was running hotter than when it was installed. Going to the wattmeter he found that his motor, together with two motors of the same size, were taking 260 kilowatts. Knowing that this was abnormal he asked the superintendent to have the shafting oiled, which was done that night. Next day this meter read 220 kilowatts; i. e., for want of oil on the shafting, these motors had been taking over eighteen per cent more current than was necessary to drive the machinery.

One set of machines may be operated when it is not advantageous or convenient to run the whole mill. Often one part of the mill gets behind and has to run part of the night. If the mill is driven by its own steam plant the engine attendant and fireman have to be kept on duty and the whole mill run, to supply power for this one part, but if this mill were buying power from a central station, all that would be necessary would be to throw the switch for the one motor and proceed to work. In this connection we have known cases when it was impossible to operate the machine shop in order to make repairs on parts affecting the main drive, simply from a want of these parts. With the machine shop driven by separate motor, this could rarely happen.

The enlargement of a mill is made independent of its relative position to the main drive. With a mechanical drive all details relating to the enlargement must be determined before the plans of the original mill are made. The engine, the boiler room and main shafting must be planned with this in view. This means a large additional cost to the mill until the enlargement is made and if the enlargement is not made, a waste of money. But when the electric drive is used it is only necessary to add another building and buy more motors. In many cases the high pressure engine is installed and room left for the low pressure side with the main pulley placed at one end of the mill. This arrangement works very well when enlargement is made shortly after first installation, but we know cases where mills have been working for years on a very inefficient basis, due to the fact that the enlargement has never been made. Again it often happens that a mill will have an available site for an additional building or wish to drive a pump that can not be reached with mechanical drive. Under such conditions electric drive displays its adaptability. Furthermore, a mill can be more readily designed to effect a saving in handling a product from one department to another.

The amount of shafting is materially decreased and a saving in frictional losses is thereby effected. This cutting down of shafting means a saving in first cost of the mill, a saving in labor and oil, and adds much to the appearance of the mill. The saving in frictional losses can not be too strongly impressed upon a manufacturer. As an illustration: The indicated horse-power of a prominent cotton mill in the city of Charlotte, N. C., with steam power was 450 horse-power; since using electric motors the power to drive this mill has been reduced to 345 horse-power, clearly demonstrating that the frictional losses of engine belting and shafting in the steam drive exceed those in the electric drive.

By the substitution of lighter belts for large heavy ones, a saving is effected in first cost and in bending frictional losses. Before the introduction of the electric drive, large heavy belts were used, but many mills electrically driven are now running with no belt wider than six inches. In the old mill several belts were used between the engine and the machine operated, and every belt meant so much slippage and a consequent loss of speed and power. This is confirmed by the common practice among cotton mill superintendents in figuring speed to allow a large percentage for slippage and in cases where mills have been changed from mechanical to electric drive by the speed being found too high, due to the fact that there was no slippage allowed for, as in the mechanical drive.

The output is increased and the quality of goods is improved. That system which maintains the speed in the machinery nearest to the maximum limit and at the same time maintains that speed constant will show the largest production. That these conditions are more nearly fulfilled by the electric drive than any other motive power is daily demonstrated in mills using this system. This increase in production is due largely to the fact that the torque is constant at all times in the motor. On the other hand the torque of a reciprocating engine varies from nothing, when a piston is at the end of its stroke, to a maximum at the middle and to nothing again at the other end. The speed, even with a heavy fly wheel, varies materially throughout the stroke and causes pulsation on high-speed machinery like spindles or warpers. These pulsations in many cases throughout the mill may be multiplied in intensity and should some weak or defective thread encounter this pulsation at a proper time, it will break. The machinery being automatic, the moment one thread breaks the whole machine stops until an operator can repair the thread and start the machine. It is due largely to the above reason that the electric drive in many cases has increased the production from two per cent to four per cent.

Lower First Cost for Small Manufacturers—If the electric drive is suitable for large manufacturers it is doubly so for small manufacturers. Many firms which are now rated high were started with very little capital and the cost of steam plant together with land and the building to install engine and boiler, was a serious consideration to such an infant industry. For many reasons boiler and engine can not be placed in a third or fourth story while a motor can be placed almost anywhere, and at a very small outlay as compared to that of a steam plant. The cost of coal combined with rental of property on which to erect a steam plant in a city is often enough in excess of what power could be purchased for, from a central station, as would make a good working profit for a small manufacturer. Especially is this true if the manufacturer uses power intermittently for his work, or has a variable load. Power that cost $30 per horse-power per year used continuously may cost $60, or even more, if used only a few hours each day, for the fires have to be kept under the boiler, and the rent on property has to be paid, whether the engine is doing its work or running idle; while in the case of electric drive the power could be shut off and expense stopped. The manager of a company in Charlotte, using three small engines before conversion to electric drive recently told the writer that their power now cost them about $2 per month more than they formerly paid their fireman.

We can safely say that the development of this mighty agent, which is such an important factor in building up one of the greatest manufacturing centres of the world, will certainly save each and every customer at least $5 to $10 per horse-power per annum on each horse-power consumed.

In concluding, we can not but insist that with its advantages, adaptability, the great saving, this mighty and mysterious agent is truly the power behind the South.

PROFESSIONAL ETHICS.[1]

BY ROSSITER W. RAYMOND.

There are a few things which are not taught in school; and among these are the ever-changing problems of professional ethics, concerning which, perhaps, age may still fairly claim a respectful hearing from youth, although it be inferior in other knowledge. And a word on this subject may be all the more appropriate now, when the ethics of business are involved in confusion by the volunteer reformers who find fierce delight or selfish gain in attacks, denunciations, exposures and "sensations."

In my judgment, men mostly try to do right, and fail chiefly in their decisions as to what is right through inexperience and incomplete knowledge.

Most of you are going to be engineers, in one or another department of that multifarious profession. All of you, I think, will be called upon to serve your generation in one or more of the following ways, namely, as authors, employés, agents or advisers. Let me offer, therefore, some suggestions, born of experience, as to the ethics of each of these positions.

As authors, take pains to think clearly, and to state your thought clearly. Faults of style are usually moral faults. Qualifying clauses out of place indicate belated after-thoughts; mixed and false metaphors declare that you have pretended to see pictures which you could not possibly have seen, because they were absurd. When a distinguished senator of the United States, complaining of the unjust criticism which he had suffered, declared that he had been "gibbeted at the crossroads of public reputation by every foul bird of passage," he was mixing two visions, professedly seen by his poetic eye, which were so inconsistent that he clearly could not have seen either. And when one of the most eminent of American orators of the last generation, arguing for universal education and universal suffrage, said (in my hearing) that the time was at hand "when Liberty would stand by every new-born child, to drop in its cradle the schoolhouse and the ballot-box," he uttered not merely a mixed metaphor, but also an implied and unconscious falsehood, because he professed to see in a poetic vision a performance which would have been fatal to every American baby, and therefore not glorious reform, but the meanest kind of murder!

[1] Abstract of an address to the graduating class at Lehigh University, South Bethlehem, Pa., June 1.

It is the product, not the process of your thinking, which you will be called, as authors, to express to your fellowmen. Don't give them unnecessary trouble in finding out what you mean to say, or on what grounds you say it; don't assert, as of your own knowledge, more than you really know; and don't hide in generalities or ornamental illustrations your actual ignorance as to this or that definite proposition.

One of the most frequent sins of authorship is the reckless use of quotation marks. Even the eminent historian Froude was guilty of this sin when he printed as quotations his own summaries and interpretations of letters in the case of Mary, Queen of Scots. I think it was the *Saturday Review* which uttered the famous verdict, justly considered to express the utmost severity of condemnation, "Mr. Froude does not understand the meaning of quotation marks!" Remember always that a quotation, making the original author responsible, must not be condensed or modified by you.

Again, verify all quotations, direct or indirect, whenever you can, and give such full references as will enable your reader to pursue the subject further for himself. If you are unable to do this, then plainly say so, referring, not to the original author of the statement you cite, but to the author whose professed quotation of it you adopted. Remember that, when you quote, you guarantee the accuracy of your quotation, and practically assure your readers that you have verified it.

As employés, think more of your duties than of your rewards or your supposed rights. Even from a selfish standpoint, loyalty commands to-day the highest price in the market.

One of the greatest inventors and mechanical engineers of the last century once said to me: "I can find many young men who are competent to erect engines, but very few whom I can thoroughly trust to do it, in complete devotion to my interest as employer."

Believe me, my young brothers, such devotion is to-day not only more honorable, but more profitable, than ever before in human history.

As agents, your duties are as clearly defined by law as by honor. Under either rule, you may not have secret personal interests, affecting your relations to those whom you represent.

Perhaps the commonest question of casuistry occurring in modern business is that of "commissions." As the agent of your employers, you have to purchase a steam engine. After getting the prices and inspecting the engines of all the manufacturers, you decide upon the machine most suitable, on the whole, for your purpose, and, in all legitimate ways, beat down the sellers thereof to their lowest price. Just as you are about to close the bargain at that price, they say, "This covers, of course, your commission of ten per cent." When you reply that you do not expect any commission, and suggest that, instead of paying it to you, they take it from the amount of the bill they send to your employers, they tell you that, according to some trade agreement, they can not charge a lower price, but can pay a commission to the selling agent. Now you are not the selling agent, but the purchasing agent; and, explaining this difference to them, you tell them that you will be in honor obliged to pay your employers whatever commission may be paid you. To this they reply, with a kindly but cynical smile, that they do not care what you do with the money after you have got it; and you see clearly that they regard your protestations of honor as part of the formula which precedes your acceptance of the money. They do not really believe that you will not keep it, if you get it.

I am repeating an episode of my own experience; and perhaps my solution may be of use to you. I declined the commission offered in currency; required it to be put in the form of a check to my order; endorsed that check to the order of my employers; and presented it to them, leaving them, if they saw fit, to return it to me as a legitimate perquisite of my position. They did not see fit; and they were quite right. But the most important feature of my action was that the return of the check, thus endorsed by me in their favor, convinced the manufacturer of my honesty as no amount of high-toned oratory on my part could have done.

As expert advisers, you may be called to counsel either private clients, or the public at large, in courts of justice.

As advisers of clients, you will encounter little difficulty in deciding what professional honor requires of you. Yet, now and then, perplexing cases may arise. For instance, you are called upon to estimate the prospects and suggest the best method of exploration of a mineral property owned by your employer. He asks you, not how much money the property is worth, but whether, in your judgment, it is promising enough to warrant the expenditure of money upon it by the actual owner. You make an encouraging report, which he afterward publishes, in whole or in part, to aid the sale of the

property or of the stock of a company to which he has transferred it, at a price never considered by you, and beyond your estimate of its present value.

In view of such a possibility, you ought, in the first place, to put into a report of this class no vague, glittering prophecies of future profit, or paragraphs which could be used, without their context, to support sanguine speculative appeals. State clearly, at the beginning of such a report, its purpose and scope. If your employer should subsequently make such use of it as would involve you in propositions you never made or meant to make, protest promptly. Such a protest, to be effectual, should be reenforced by your own original and carefully guarded statement. Nevertheless, make it anyhow, and make it promptly, if you deem it worth making at all. Post-mortem disclaimers by experts, after the collapse of mining schemes with which their names have been fairly or unfairly connected, have very little effect. You can not be too careful to make your record absolutely plain, and to protect it, by instant protest and exposure, against even the appearance or suspicion of connivance in delusion or deceit.

Again, you may have occasion to appear as expert witnesses in court. Such witnesses are called in cases involving patents, mining titles, the detection of poisons, the details of medical practice, or the value of professional services, etc.

Expert testimony has been, and is, the subject of endless controversy. It is often urged that experts should be appointed by the court, to give advice without favoring either party. This is, in fact, done in criminal cases, where analyses are made for poison; in cases of alleged lunacy, etc.; but I think experience has shown that in ordinary litigation, especially as to patents and mining titles under our laws, justice is best secured by allowing each party to present its own experts, requiring them to submit to cross-examination, and leaving the bench and the jury box to pass judgment upon the evidence. The difference between an expert and an ordinary witness is that the former is permitted to give his opinions, however reached, while the latter can give only facts of personal knowledge. The oath of an expert, therefore, binding him to tell "the truth, the whole truth, and nothing but the truth," covers the ordinary obligation as to facts, and also the obligation of the full and truthful statement of expert opinion. Yet there is no doubt that this opinion must be, to some extent, a partisan one. No party to a lawsuit will put an expert on the stand without knowing beforehand that his opinion will be favorable to the contention of his employer. Nor would any such expert be doing his duty, either to the court or to his employer, if he uttered an opinion so carelessly formed or loosely held that he could not vigorously defend it, or would run the least risk of changing it under cross-examination. The situation is often complicated, critical and exciting. The following suggestions may assist young experts to deal with it:

When such an engagement is offered to you, accept first a retainer for which you undertake to examine the case, form an opinion, and state it to your employer. In a mining case, two such preliminary investigations may be necessary: the first being based upon the *ex parte* case, submitted to you by one side, and the other upon your own personal examination of the facts. After the latter, state clearly to your client the opinion which you are prepared to maintain. If it does not support his contention, he will not wish to put you on the stand as a witness; but you are bound not to assist, either in that case, or (without his permission) in any other, involving the knowledge you have acquired in confidence from him, parties whose interests may be hostile to his.

If you take the stand as an expert, you ought to know already all the facts and authorities which bear upon your opinion. Whatever has been previously adduced in the pending case, you should, of course, have taken into account. What is produced which takes you by surprise, you should not meet with a rash denial or quibble. Your true and wise course is to declare that you are giving your deliberate and careful opinion upon all the facts known to you, and you can not hastily revise that opinion upon new evidence, which you can not, in a moment, test, sift and weigh.

Don't try to be smart or witty under cross-examination. Such an encounter is like a fencing-match in which you have your hands tied. For you are answering under oath, while the enquiries and insinuations of your antagonist are unrestrained. Maintain your opinion manfully; but do not even seem to be fighting for your client. Still better: do not fight at all, but assume throughout that the cross-examination attorney is honestly in quest of information, and give it to him with courteous generosity. If you thus give him no opening for insulting comment, he will probably not make any. If he should do so, do not try to protect yourself, but let your counsel, or the court, protect you. I have seen a witness get the better of a lawyer in repartee, and lose the case; and I have seen witnesses browbeaten and embarrassed by clever lawyers, but vindicated by the verdict of the jury, which could not be diverted by mere wit from its search for truth and justice.

If you are called upon to answer categorically, yes or no, a question ingeniously so framed as to involve through such an answer some misconstruction of your opinion, do not fence, dodge or quibble, as if you were afraid to meet the issue, but give at once the categorical answer demanded, and immediately ask the court to permit you to make an explanation. This is your right, and will be promptly granted, while your enemy gnashes his teeth.

It happens sometimes, in mining cases, that an expert, after the trial of a case in which he has testified, is obliged by later developments to change his opinion. For instance, in a certain lawsuit, it is a vital question whether a certain mining claim exhibits two lodes, or only one. You testify that there are clearly two. But deeper mining shows these two to have united, so that there is, as you are obliged to acknowledge, only one.

Such changes of scientific conclusions are common enough. We are all revising our old views upon new evidence. But permit me to urge upon you a rule of policy which is most important. If you have once advocated under oath, and for an expert's fee, a given opinion, do not announce your recantation of that opinion as a paid expert. Put it in a technical journal or book, if you like—but do not let yourself be caught in a situation where you have to explain it to a jury! If you ask me whether you have not a perfect right to announce anywhere an honest change of opinion, I reply that it is your duty not to do an honest thing in such a way as to incur a probable suspicion of dishonesty. You might honestly call upon me in Brooklyn as a stranger, and tell me that you had had your pocket picked of nearly all your money, and lacked forty-nine cents to get you back to South Bethlehem. But you had better foot it back to Bethlehem than bring me that story! Honest people have no right to act like impostors! And, to return to the instance I have given, if you have once appeared as the defender before judge or jury of an opinion which you have been subsequently obliged to abandon, make your new opinion known (if it be of sufficient importance) in some clearly disinterested way; but not

under circumstances which might cast suspicion upon your sincerity.

Is there no general formula by which a man may be guided in all such questions of casuistry? The Ten Commandments, the Golden Rule, are formulas which often prove difficult of application, or easy of evasion, in concrete cases. Let me suggest to you, for rough practical use, a maxim, apparently (though, I think, not really) framed on a lower plane.

"Do nothing that you can not tell."

If there be any doubt as to the matter, tell it anyhow to the parties affected by it. If there be no reason for telling it at the time, make a complete and unchallengeable record, for the possible future use of yourself, as well as of others. To forget circumstances may be equivalent in effect to hiding them. It is mortifying indeed to face the partial record of some old transaction which you know was all right, but can not now prove it so, because the stub of your check-book shows no particulars!

In these days especially, we are learning the folly of secrecy. On every side, eminent men, and (I make bold to say) really honorable men, are incurring disgrace by reason of acts hidden either from them or by them. Some of these acts they might be able to defend, but for the damning suspicion attached to the circumstance of concealment.

It may be—and to speak frankly, such is my personal opinion—that the present excited public feeling is in great danger of going too far in its hasty and indiscriminate condemnation of alleged evils. But that is not the question that I am now considering. My present deduction from the prevalent chaos of accusations is this: if many things, now represented, or misrepresented, to us as scandalous abuses, had been openly done from the beginning, how much more comfortable good men would be! And, on the other hand, how many things which could not have been done openly would never have been done at all!

Certain it is that men "love darkness rather than light," when "their deeds are evil." If you are not of such, why not walk always in the light?

At the joint meeting of the American Institute of Mining Engineers and the Iron and Steel Institute, commencing in London July 24, the following papers will be read:

"Belgian Practice in Large Gas Engines," by Professor H. Hubert (Liège); "Electric Steel Smelting," by E. C. Ibbotson; "German Practice in Large Gas Engines," by K. Reinhart (Dortmund), and "British Practice in Large Gas Engines," by T. Westgarth.

BOOK REVIEWS.

"The Practical Testing of Dynamos and Motors." Second edition, enlarged. Charles F. Smith. Manchester, England. Scientific Publishing Company. Cloth. 306 pages. 6 by 9 inches. Illustrated. Price, 5 shillings.

This manual for the electrical engineering laboratory describes the methods of conducting the tests usually carried out there. It gives the methods and the apparatus for making electrical measurements, of testing iron, and of conducting tests on direct-current dynamos and motors. It does not go into the analytical side of testing, but it does give excellent directions for conducting such tests. It leaves to the student, as is proper, the work of digesting his results and drawing his conclusions.

"American Street Railway Investments." 1906 edition. New York. McGraw Publishing Company. Cloth. 432 pages. 10 by 13¼ inches. Supplied by the ELECTRICAL REVIEW at $5.

The thirteenth annual edition of "American Street Railway Investments" covers 432 pages of statistical matter, an increase of seventeen pages over the edition of 1905. This increase is due partly to the addition of reports from new roads, partly to more complete statements from roads which have previously reported, and partly to the publication of a considerably greater number of maps of operating properties than have appeared in previous editions. Forty-nine maps are given, showing the systems of fifty-two separate companies. The same general arrangement of the reports has been adhered to, and the indexes are exceptionally complete.

"Steam Turbine Engineering." T. Stevens and H. M. Hobart. New York. The Macmillan Company. Cloth. 814 pages. 6½ by 9 inches. 516 illustrations. Supplied by the ELECTRICAL REVIEW at $6.50.

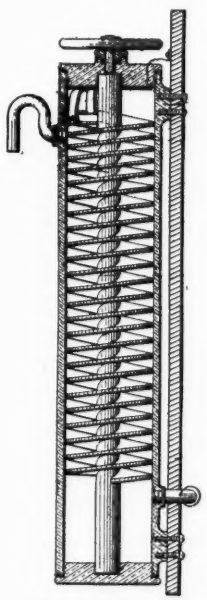
It has been the endeavor of the authors of this book to deal with the subject from the standpoint of the purchaser and user of steam turbines. The latter is only incidentally interested in the theory and design of the turbine, but he is doubly concerned in the question of its economy, not only as regards steam consumption, but also as regards first cost and maintenance. A vast amount of data has been compiled, which is presented in tabular form and in the shape of graphical figures relating to tests of a large number of turbines under various conditions. From these tests other results are deduced, representing standard conditions, which enable a comparison to be made of the different machines. The different types of turbines, as well as the different makes of turbines of the same type, are discussed in detail, special features of mechanical design in each case being pointed out. These machines include English, American and Continental makes. This is followed by a discussion of the performance of reciprocating engines, in order that a comparison may be made between these prime movers and the steam turbines. The effects of steam pressure, superheat and vacuum on the turbine performance are considered. This is followed by a discussion of the construction of the power plant, and descriptions are given here of a large number of modern installations. The book concludes with a discussion of the steam turbine as applied to marine practice. The authors have, undoubtedly, expended a large amount of time in compiling a great deal of useful information, and they have spared no pains to reduce this to such a form that the purchaser can avail himself of it. A minor feature of the book which may be criticized is the poor character of many of the illustrations. Photographic processes have been so developed that there is to-day no excuse for a blurred and indistinct illustration, and when a photograph of the device may be had for the asking there is still less excuse for rephotographing from a half-tone. This has been done in a number of instances in this particular work, which gives it a slovenly look. It may be said that it is not alone in erring in this way, for a number of English books have come to hand recently in which the same inexcusable practice has been followed. Perhaps in this case it is a little more offensive than usual.

"Industrial Furnaces and Methods of Control." Emilio Damour. Translated from the French by A. L. J. Queneau. New York. *The Engineering and Mining Journal.* Cloth. 218 pages. 6½ by 9½ inches. Illustrated. Supplied by the ELECTRICAL REVIEW at $4.

A preface to this work has been written by Professor Henry M. Howe, of Columbia University, who says: "Mr. Queneau has here laid the industrial world, and especially the metallurgical world, under great obligation for bringing together his own admirable translation of Damour's admirable work, and welcome chapters by himself and Dr. Bolles on the control and efficiency of heating operations through pyrometry and chemical analysis, and on the design of chimneys and regenerative gas furnaces." The work consists of a description of various types of furnaces; a theoretical study of recuperation; a discussion of pyrometry by Mr. Queneau, and a chapter on calorimetry by M. N. Bolles. Part III deals with the theory and design of chimneys.

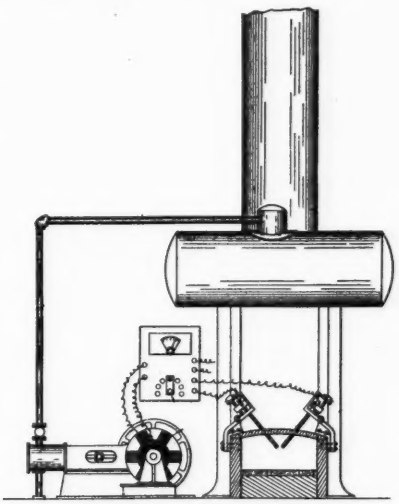
Electrical Patents.

Albert E. Dieterich, Washington, D. C., has obtained a patent (823,671, June 19) for an improved electric water purifier, which he has assigned to E. E. Sager and F. E. Holt. This invention relates to a certain new and useful improvement in electrical water purifiers in which water is purified by electrolytic action in the presence of aluminum electrodes. In its generic nature the invention includes a casing, a pair of aluminum electrodes held therein in the form of spiral screw and means for rotating this screw at times to eject the precipitate, and means for rendering the electrodes electrically charged. Primarily, the invention seeks to provide a device of this character of a very simple and effective construction, which can be easily and cheaply manufactured and in which the parts can be readily assembled, or detached from one another for purposes of repair or cleaning, and in which means are provided for ejecting the precipitate from the apparatus without removing the electrodes. The invention comprises an open-ended cylindrical casing, closure plugs for each end of the casing, the closure plugs being formed with bearing portions, a rod held in the bearing portions between the closure plugs, a pair of spiral electrodes held on the rod and in engagement with the walls of the casing to form spiral water passages from one end of the casing to the other, the casing extending beyond the electrodes, to form a collection chamber, a water inlet for the casing at one end thereof, and a water outlet for the casing at the other end thereof, a pair of contact-plates carried by one of the closure members, contact-brushes carried by the electrodes for engaging the contact-plates, and means for connecting the contact-plates with an electric circuit.



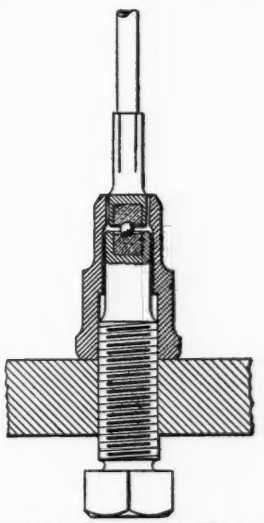
WATER PURIFIER.

Enrique A. Touceda, Albany, N. Y., has obtained a patent (823,560, June 19) for an improved art of metallurgy. The principal objects of this invention are to secure greater economy in time and fuel and to permit without increased fuel expense a wider range in the chemical composition of the material under treatment in the operation of metallurgical furnaces. The invention consists in the method of procedure, whereby heat of comparatively low intensity escaping from a metallurgical furnace is converted into electrically generated heat of comparatively high intensity and returned within the furnace. The invention is applicable in the use of various kinds of metallurgical furnace adapted for burning solid liquid or gaseous fuel, and it is particularly adapted for use in a non-regenerative reverbatory furnace in the process of preparing iron for malleable castings. To this end, the inventor places a steam boiler between the hearth chamber and the stack, so that it will be heated by the products of combustion passing from the former to the latter. Connected to this steam boiler is an engine, which drives the dynamo, and the current generated by the latter is employed for forming an electric arc adjacent to the hearth within the furnace, thereby producing an additional heat.



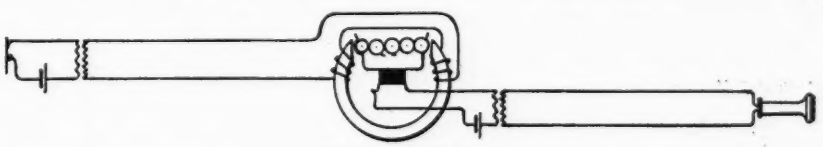
METALLURGICAL FURNACE.

An improved bearing for electrical measuring instruments has been invented by Walter Ehmsen McCoy, of New York (824,194, June 26, 1906), and he has assigned the same to Westinghouse Electric and Manufacturing Company, Pittsburg, Pa. The invention relates to electrical measuring instruments, particularly those of the integrating or registering type, and it has for its object to provide effective and durable bearings for the spindles of the rotating members of such instruments. The invention consists of a bearing for an electrical measuring instrument shaft or spindle comprising an adjustable stud provided with a jewel having a concave bearing surface of single uniform curvature, a jewel mounted in the end of the shaft or spindle and having a concave bearing surface of single, uniform curvature and a polished steel ball interposed between the bearing surfaces and having a radius of curvature that is less than that of the bearing surfaces.



BEARING FOR ELECTRICAL MEASURING INSTRUMENTS.

Edward E. Clement, Washington, D. C., has obtained a patent (823,763, June 19) for an improved telephone relay. This invention relates to telephone relays wherein in a translating device included in one circuit in which current is being periodically varied to correspond to sound undulations reacts upon a second translating device to reproduce variations in a second and independent circuit. The object is to eliminate what is known as the "time constant," or, at least, to so reduce it as to permit of the production of electrical undulations in the second circuit corresponding to the original sound waves without appreciable distortion.



TELEPHONE RELAY.

Reviews of Current Engineering and Scientific Literature.

Power Gas Transmission.

In this section of a series of articles on gas-producer plants and gas engines, C. A. Smith discusses the dangers incident to the use of gas, the thermal values of the various kinds of gas, and the economy which may be obtained. In pointing out some of the possibilities of power gas he says that it is especially in transmission work that the great future of a cheap producer gas lies. It will even be found superior to electricity for transmission purposes. It has only been recently that the centralized generation of power has been considered. Until such a method of transmitting or distributing it was discovered it was useless to consider method of transmitting or distributing it application of electricity has completely altered the whole question, and has been the main factor in bringing about the development of large power schemes and the great reduction in the price paid for power in most districts. More recently, a great impetus has been given by the invention of what is popularly called producer gas. Of recent years a good deal has been said about generating electricity at the mine and transmitting it to various industrial centres, but it will be considerably cheaper to manufacture producer gas at the same point and transmit it through pipes to the industrial centres, there to be used for driving engines for generating electricity and also for heating purposes and furnace work. The questions of the distribution and transmission of power must not be confused. For the former it is agreed that there is no agent to compare with electricity. For the latter it is suggested that it is more economical to employ producer gas and pipe than electricity and cables.—*Abstracted from the Engineering Times (London), June* 21.

Electrical Measurements of Very Short Time Intervals.

In physical researches the duration of time intervals is usually determined by means of a moving body. This may be a body which is allowed to fall, an oscillating pendulum or any form of chronoscope. Such devices involve in their use errors which are difficult to estimate and hard to avoid. A simple method of measuring such short time intervals is described here by M. Devaux-Charbonnel. It depends upon the fact that certain electrical quantities involve the fundamental physical dimensions, one of these being the unit of time. This quantity frequently occurs in a simple expression, such, for example, as that for the discharge of a condenser closed on a resistance. By determining the difference in the charges on a condenser at different times, the time interval which has elapsed can be computed if the constants of the discharge or charge circuits are known. A simple method of doing this is to connect the condenser in parallel with a known resistance, and across both apply a known potential. A steady current will then flow across the resistance, and the condenser will take in a known charge. If, then, a falling body actuates successively two switches, one of which opens the charging circuit, leaving the condenser to discharge through the resistance in parallel with it, and the second closes the condenser in circuit with a ballistic galvanometer, through which it will discharge quickly, the throw of the galvanometer will determine the quantity of electricity discharged by the condenser. The difference between this and the charge which it originally held is the quantity which has flowed through the resistance during the time intervening between the operation of the two switches. As all the electrical quantities entering into this determination can be measured accurately, this time can be computed with corresponding accuracy. The method may, of course, be applied in a number of ways for other purposes.—*Translated and abstracted from L'Électricien (Paris), June* 23.

Electric Power on the Great Western Railway, England.

Although a number of the railroads running into London have been equipping their suburban systems with electric cars, they have not yet all fully realized the advantages of the change, because it has been necessary to run in between electric trains, trains hauled by steam locomotives. Thus, although the change in motive power made a higher schedule speed and a more frequent service possible, the presence of the steam locomotives prevents this being realized. Of these roads, the Great Western is probably furthest along in its change. On this road the work of fitting up for electric traction on the suburban lines has been completed, and the steam trains removed, so that at last it will be possible to obtain the improved train service on the Circle. The power station for this company is at Park Royal, and is equipped with eight 750-kilowatt, three-phase generators, each driven by a triple-expansion engine running at 250 revolutions per minute. There is, in addition, a storage battery charged by means of motor-driven boosters, and an auxiliary plant of two 150-kilowatt, 660-volt, three-phase generators, the power from which is used for driving auxiliary machinery in the plant. Steam at 200 pounds pressure per square inch and 150 degrees Fahrenheit superheat is supplied from water-tube boilers. The steam pipe is of solid drawn steel tubing, arranged on the ring system in the engine room, and in duplicate in the boiler room. The main generators deliver current at 6,600 volts, fifty cycles per second, which is transmitted by three-core, paper-insulated, lead-covered and armored cables laid underground on the solid system. Power is transmitted to three substations, the furthest being five miles from the generating station. At these points the current is transformed by means of motor-generators to 630 volts, direct-current, at which pressure it is supplied to the third rail. There are eleven distributing centres where 6,600-volt current is transformed down to 110 and 220 volts for lighting purposes. At each of these centres there are two sets of three transformers, each set being capable of handling the maximum load. Current is supplied to and taken from the train by means of two conducting wires. The positive conductor is placed on one side, sixteen inches from the running rail and three inches higher. The negative rail is placed on the other side, twenty-eight and one-half inches from the running rail and one and one-half inches above it. These rails are of channel shape, and supported on cast-iron caps cemented into porcelain insulators attached by iron clips to the ties. The rails are not fastened to the insulators, but are free to move, so that the latter will not be broken by the strains due to the motion of the ties as a train passes. The conductor rails weigh 102.8 pounds per yard, and have a conductivity equal to fifteen, with copper taken as 100. They are divided into sections of approximately the same length as the distance between stations. — *Abstracted from Engineering (London), June* 15.

The Relative Proportion of Radium and Uranium in Radioactive Materials.

Some time ago Messrs. E. Rutherford and B. B. Boltwood gave an account of measurements which had been made to determine the amount of radium present per gramme of uranium in natural minerals. Previous experiments had shown that the amount of radium in a mineral was always proportional to its content of uranium, and it was pointed out that the weight of radium present per gramme of uranium was a constant of considerable practical and theoretical importance. The method adopted for the investigation depended on the preparation of a standard solution of radium bromide, and the amount of radium emanation formed in it was compared with that formed in a radioactive material containing a known quantity of uranium. Since the electrical comparison of the various amounts of radium emanation can be made with considerable precision, the accuracy of the results was mainly dependent on the exactness with which the solution of radium taken as a standard had been prepared. This standard solution was prepared by Rutherford and Eve, the material used being taken from some stock crystals whose heat constant was known. The result of the experiment was that the amount of radium corresponding to one gramme of uranium in a material should be 7.4×10^{-7} grammes. Recently, however, some experiments made by Eve indicated that the solution used for the above determination was in some way defective, and that the quantity of radium actually in solution was less than had been assumed to be present. It was found that a considerable portion of the radium had been deposited on the surface of the glass vessel in which the solution had been preserved. A new standard solution has since been prepared with the greatest care, using in this case as the solvent dilute hydrochloric acid. The previous standard had been prepared with pure water. The new solution was boiled vigorously, and then allowed to stand for exactly four days, at which time the emanation which had accumulated was removed and transferred to an electroscope, and its activity measured. From these measurements it has been calculated that the quantity of radium associated with one gramme of uranium in a radioactive material is equal to approximately 3.8×10^{-7} grammes. The new value is about one-half of the old. It follows from this figure that a ton of sixty per cent uranium ore will carry about 0.2 gramme of radium, or 0.35 gramme of radium bromide. These numbers are more nearly in accord with the quantities of radium extracted from the ores in actual practice than were the previous figures.—*Abstracted from the American Journal of Science (New Haven), July.*

The Magnetic Survey of the North Pacific Ocean.

Some preliminary results are given here by Dr. L. A. Bauer of the magnetic survey of the Pacific ocean which is being carried out by means of funds supplied by the Carnegie Institution, of Washington, D. C. The author first dwells upon the necessity for this survey, pointing out that, except for the voyage of the British vessel, Challenger, this, the largest of the oceans, is practically a blank as regards our magnetic knowledge. All information known regarding it, except that mentioned, has been derived from observations made on or near the coast. Attention is further called to the fact that our magnetic charts are, in general, no better to-day than they were in 1845, for, although many magnetic surveys have been made, the charts are still completed by referring to old observations. The vessel selected for this survey was the brig, Galilee. She was altered somewhat to make her more suitable for the work, all the steel rigging being removed and replaced with Manila rope. A wooden bridge was erected fifteen feet above the deck, thus placing it twenty-five feet above all large bolts—far enough away to reduce the disturbance the latter might cause to a very small amount. The vessel is not entirely non-magnetic, but, from tests, it was found that the deviations caused by her were less than with any other vessel used for such surveys. She is 132.4 feet long and has a displacement of 600 tons. The first cruise was made in December last, observations being taken at various places on the shores around San Francisco. In this way the most suitable place for swinging the ship was determined. During this work the vessel was swung by a tug, but after putting out to sea she was swung under sail. On account of the delay caused by this method of working, a naphtha launch was added to her equipment later. After the first trip to San Diego the Galilee left for the Hawaiian Islands and made several complete circuits, covering a distance of over 10,000 nautical miles. It was found that the instruments with which she was provided could be used at sea with considerable accuracy, the greatest trouble being due to fogs, which made it difficult to take declination observations. Descriptions are given of the instruments employed in the survey and of the methods of using them. The general conclusions resulting from the work so far accomplished are that on a vessel like the Galilee, with the small deviation coefficients encountered at the positions of the various instruments, the measurements need not be much inferior to those made on land. The dip of the needle can be determined within five minutes of the absolute value, and the horizontal component of the earth's magnetic force to about one part in 500. In a moderately rough sea the average results are not so accurate, but are still satisfactory. The data obtained are compared with the British Admiralty and the German Admiralty charts. They show that the British chart is, on the average, more correct than the German, though both charts show values too small for the eastern declination. The latest charts for lines of equal horizontal intensity give uniformly too high values, on an average about one part in twenty-five.—*Abstracted from Terrestrial Magnetism and Atmospheric Electricity (Baltimore), June.*

Underground Telegraph Wires in England.

A letter written recently by the British postmaster to the Association of Chambers of Commerce deals in the following way with the work of laying all telegraph trunk lines underground. Up to the present time the underground line between London and Glasgow has been completed. The spur line to Manchester has been continued through Bradford to Leeds, and, in the south, an underground line has been laid from London eastward as far as Chatham and westward as far as Slough. Thence a pipe has been carried as far as Reading, though the cable has not yet been placed. During the present year it is hoped that this pipe line will be extended to Bristol, and that the cable will be carried as far as Chippenham. The department is carrying on the work of laying the wires underground as rapidly as possible, and has in contemplation extending this underground system of cables to the landing places of important Atlantic and Mediterranean cables throughout Great Britain.

Train Service via Simplon Tunnel.

As a consequence of the opening of the Simplon tunnel in May, a train *de luxe* is now run tri-weekly between England and Italy *via* Calais, Paris, Lausanne and Milan. Two day and two night express trains are also to be run between Paris and Milan through the tunnel.

Methods of Getting New Business.

A department devoted to the commercial development of Central Stations. Managers are invited to contribute suggestions for methods of increasing the demand for electric service.

ORGANIZATION AND CONDUCT OF A NEW BUSINESS DEPARTMENT SUITABLE FOR CENTRAL STATIONS IN CITIES OF 50,000 POPULATION AND UNDER.

BY M. S. SEELMAN, JR.[1]

(Concluded.)

Here is a point that should be borne in mind: Never send out a piece of advertising matter without enclosing a return post card. A fundamental law of political economy is that man is a lazy animal and you want to make the path to your front door as easy and smooth as possible. Each different branch of the business should have its distinctive return post card, so if you send out a lighting circular you enclose a lighting post card; a sign circular, a sign post card, and the same with power, fans, heating and refrigeration, if you go that far. Don't make it a postal card; that is expensive; but an attractively printed post card with your address and place for one cent stamp on one side and on the other a printed form referring to the matter in hand and space for the name and address of the sender. I have experimented as to the relative advertising value of the penny United States postal card and the plain post card for this return work, and find that while the cost is as six to one the latter is nearly as effective as the former. This return post card method gives you a fair chance to estimate the interest your advertising is arousing and leads, if the advertising is right and other things being equal, to a continuous and often surprisingly large amount of new business.

The system of doing the bulk of your advertising by mail distribution of circulars, booklets, etc., rather than through the newspapers is the best because you reach, if your campaign is rightly conducted, just the people you wish to reach and with the least waste of expensive publicity. Your list of prospects is a good list to work on and that can be supplemented by special lists for special purposes, as for instance, a sign list composed of present store customers and stores not yet using the service but whom you hope some day to secure. Your sign proposition may be the entering wedge.

[1]Winner of the $500 prize given by the Cooperative Electrical Development Association, Cleveland, Ohio.

And this brings us now to another very important feature of and factor in a new business campaign, and that is the special propositions.

And right here I want to say that if you want to get a big share of new business, you have got to be liberal, you have got to go half way to meet the customer, you have got to be willing to spend a dollar to make two.

A good many companies are ready to make extensions, even in cases where it takes quite some time to get back the original investment, not to mention a profit, yet they turn away haughtily from the proposition to supply a customer with some equipment which in a far shorter period pays for itself and gives a handsome return on the money invested.

There's the free sign proposition for instance; it has proven "good business" everywhere it has been tried, so far as I know. A panel sign costs you complete about $45; with overhead construction, customary in the city of 50,000 or less, to hang and connect the sign ought not to cost more than $25. Here's an investment of $70. Take 200 per cent of your investment—$140—divide it in twenty-four parts and offer your customers free signs on a two-years' guarantee of $6 a month. You are sure to get back the cost of the sign and installation well within the two years, even if the customer's current bills do not run above the guarantee (which is unlikely). As a matter of fact you usually get back the actual cost, including the proportion of operating expense, within the first year and all the rest above percentage of operating work is "velvet," especially as in fully ninety-five per cent of cases the customer keeps on using the sign far beyond the two years of his contract. Not only this, but each sign you thus erect is a good advertisement for you and helps bring another, besides being, as aforesaid, in many cases an opening wedge for other business with the customer, and you retain title to the sign; so that in case of the worst your loss must be small, as the sign with slight changes can usually be utilized for some other customer.

With individual letter signs the return of the investment with profit is even more rapid than with the panel sign because they use more current in proportion to their cost to you. When giving an expensive sign, however, care must be exercised as to the financial responsibility of the recipient.

Still another advantage of the electric sign proposition is that it leads the merchant to realize the advertising value of electric light, so that he not only burns his sign at night, but is likely to get in the habit of keeping his windows illuminated some hours after closing, and this again leads others to do the same. Such night lighting has a far-reaching effect in creating new business for the entire town, increasing the activity and energy of its life and materially assisting in its development.

The sign is a good advertisement to the customer too and economical as well. Suppose it costs him $10 a month for lighting it. How much newspaper advertising could he buy for that amount? How many circulars can he print and distribute? Why, it would cost him that much to buy a thousand postal cards without the charge for printing and addressing them, while his sign, for $10, is brightly visible for three or four hours every night to every one who passes the store, giving it a distinctive character and "burning his name into the public mind."

The town in which this free sign proposition will not "take," if it is properly advertised and pushed by the new business organization, must be dead indeed.

Then there are the special lamp propositions. There are doubtless many stores in the city in which we are hustling for new business, that are illuminated by the gas arcs or Welsbachs, which we find it impossible to touch with the ordinary standard incandescent lamp proposition. Here is where the Nernst lamp comes in, also the high-efficiency and meridian lamps. Each has its place. The Nernst is an attractive proposition to a customer especially a lamp about three-glower size. It is highly attractive, even decorative, in appearance, gives a beautiful pearly white light and is in every way far superior to any gas lamp, being at the same time so efficient in wattage as to permit of free competition with gas. And from the station's standpoint it is not nearly so expensive of maintenance as—from some reports—we might be led to believe. If our

friends who are out after new business will supply these lamps free with free glower renewals, even with free wiring and installation for outside lamps, they will find this proposition a potent factor in securing new and profitable customers, and the stores where you install the lamps outside will most likely soon install them inside at their own expense. The meridian and high-efficiency lamps can also be worked in the same way, either in direct-current districts or on overhead circuits, where the customer, having his choice, may select one of these types as preferable. The new decorative and highly efficient "arc" clusters that have recently been placed upon the market may be utilized to advantage where the customer is disposed to complain of the arc lamp, at arc lamp cost of operation. They give adequate illumination of fine quality at a very low cost. With these, as with signs and other lamps, don't be afraid to go half way to meet your customer.

A method of getting one class of new business which has worked well in at least one large city, but which might or might not be applicable to the city of 50,000 or less, can be utilized with the drug stores.

Here hours of burning are long and the average drug store may not be able to afford the average rate for the average installation. Still you can not cut rates for him and be consistent. Get up an attractive advertising bulletin stand of wood and iron that will cost you about $15, with a frame in the top portion for a placard and beneath this pockets for bulletins and other advertising matter. Then make an arrangement with the druggist now using gas that in consideration of his permitting you to keep your advertising stand in a prominent place in his store you will pay him a sum, which subtracted from the bills at regular rates for lighting his store by electricity will make such illumination economical for him. The placards, bulletins, circulars, etc., are changed once a month. It is good advertising for the central station too, because as a rule the right kind of people deal in drug stores and while awaiting the compounding of prescriptions have time to read your advertising, which is placed where they can not help but see it.

One way to get at a gas-illuminated store is to offer to draw, gratis, plans for the electric illumination of the store which will provide a lighting far superior to gas, adding materially to the attractiveness of the establishment at a price little, if any, heavier than the storekeeper has been paying for an inferior illuminant. This can be done by selecting the right kind of lamps and glassware and arranging them to advantage. One of your canvassers could easily be educated to do this class of work. Once the plans are drawn, the storekeeper is very apt to become sufficiently interested to wire up and sign a contract.

Now as to residences and new buildings. In the average town of 50,000 there will be found about six architects, in the town of 25,000, three. One of the first acts our new general agent must do is to set himself to get acquainted with these architects, not alone in a business way, but, if possible, socially, so that a feeling of friendliness may spring up between them. Let him join their clubs, take them out to dinner, etc. After this "entente cordiale" has been established, our general agent is in a position to know from the start what is taking place in the line of erecting new structures and he is less likely to be called upon to continually fight the installation of isolated plants. Get the architects on your side.

Then, of course, the building permits must be followed up closely. Let no guilty man escape. Every new building must be wired, and the way to do this is to see the builder the day his permit is issued (before, if possible) and to follow him right up until the business is done. The same with permits for alterations. When the owner is about to make alterations in his home or store, that is the psychological moment to approach him about installing an electric illumination on the premises. These are new business pointers that can not be neglected.

A far stiffer proposition than the new residence is the unwired old one, and yet there are doubtless hundreds of these—even in a city of 50,000—which if wired would yield a fair and certain revenue. How to get them wired is the problem. Your advertising helps by bringing the householder to a realization of the many advantages and conveniences of an electric service. Then it is a good plan for your canvasser to call in the daytime, get the "lady of the house" on his side and then make an appointment for evening after supper, when the householder is likely to be in the right frame of mind and the canvasser can meet wife (already predisposed in his favor) and husband together. May and June are especially good months to canvass residences in, because families who are out of town in July and August can arrange to have the wiring done in their absence, saving them some inconvenience.

But there are householders who would like to have an electric illumination who do not feel that they can afford to pay out the cost of wiring in a lump sum. If these be reputable citizens let the company help them out by financing the deal, the money to be repaid within a year in monthly instalments. If this wiring would cost $200 to $250 and that is more than the householder wants to spend, suggest to him that he wire his living rooms—dining room, kitchen, cellar, back parlor, parlor and lower halls, which can be done within $100, including fixtures.

The above refers to cases where the tenant is also the owner. Where he is not the owner the difficulties multiply. Here is a plan or scheme that might prove efficacious under the latter circumstance and is worth while trying where neither landlord nor tenant is willing to pay the complete cost of wiring. Approach the tenant and tell him that you can appreciate the fact that he is unwilling to spend from $100 to $250 in improving somebody else's property, but that it certainly is worth something to him and his family to enjoy the comforts, conveniences and elegancies of an electric service. Then make this proposition to him: if he will see his landlord and get the landlord to pay one-third the cost of wiring, and he (the tenant) will pay another third, the company will pay the remaining third of the bill. This ought to be an attractive and paying proposition for landlord, tenant and company.

You can secure residence lighting, also, planning on paper an appropriate illumination for some particular home and interesting the resident in these plans. It is a case of being alive and hustling.

In pushing electric heating and cooking devices some companies have acted in cooperation with the department stores. From personal experience, I should say it is better for us to go it alone and let the department store do the same. Our standpoints and purposes are widely different. The store sells the appliance for the profit in the sale and the profit must be a large one, for sales are necessarily limited in number. The central station's object is not to make a profit on the sale, but to get the appliance on the system where it will use current. For a General Electric six-pound iron, for instance, the store charges $4; the iron cost the central station about $2.85 and the latter is glad to sell it for $3 if an arrangement with the store does not tie its hands; and you can sell four irons at $3 to one iron at $4.

The method which has been most successful in placing irons is to send them out on trial, putting one in every house equipped for an electric service. In the

city of 50,000 or less, I would advise either using one of your canvassers for this purpose throughout the city, or else making each canvasser take care of his own district in this respect. Load the irons in an auto, and when leaving each iron for a trial of from thirty days to three months, have the canvasser give a little selling talk and leave a neat circular calling attention to its many advantages. Also let him leave a postal card addressed to the company, explaining that it is possible, though not probable, in first using the iron that some trifling trouble may be experienced, in which case, tell the customer not to condemn the iron but to send the postal card, when the company's representative will call and straighten out the kinks. The iron is all right and if followed up in this way is bound to prove a boon to the housewife and a source of revenue to the company.

As a matter of fact, these irons could be given away with profit by the central station. They cost, say, $3, and bring in a revenue, which begins the minute they are placed on the system, of about $1 a month. In three months the first outlay is returned, in six months the iron is completely paid for out of the profits, and becomes from that time a constant agent of profitable income. And it is day load, too. In those cities where you may fail in securing the $3 for the irons—give them away.

Other heating and cooking devices are not so valuable to the central station as the iron, but they all have their place in popularizing current. You have your display of them in your showroom. Get up a "demonstration." Hire an attractive young lady to do the cooking and send out invitations to your customers. Give them something dainty to eat and a small souvenir of the occasion. Have your advertising and your men follow this up and you will sell a sufficient number of appliances to make it pay.

The use of electric fans can be increased by judicious advertising and canvassing; and if you are not afraid of complications with contractors and supply dealers, by selling them at a low figure—a price approximately cost. If you have considerable surplus supply, rent them out for the summer months.

I have purposely kept the subject of increasing the power business to the last, because it is at once, being primarily day load, of the utmost importance to the central station, and at the same time ordinarily the most difficult to secure.

First of all, let me say that while it is possible to secure lighting business at a higher price than is paid for other illuminants, because of superiority and also because average installations are of such size that isolated generating plants are impracticable, to get any large slice of new power business, your price has got to be right, for even if you can go into a factory and demonstrate how by cutting out friction load you can largely reduce the energy required to turn the wheels, if your rate for current is too high there is nothing to prevent the mill owner from taking advantage of your trip, eliminating much belting and shafts, installing motors and putting in his own dynamo.

Power business is such good business that special effort to get it is well worth while. If within the limits of possibility make your rate right to begin with.

It is more difficult to secure a good power canvasser than the other kind. If your general agent is enough of a technician and sufficiently familiar with power problems to handle this end of the business, that is a tremendous help. If not, and there is much power business in your town, then, in addition to your other canvassers, you will have to hire a power expert.

The way to get power business is to get it. There must be energy, enterprise and indomitable tenacity on the part of your power man, backed up, on the part of the company, by a readiness to help and a willingness to be liberal. I know a general agent, who is also a power man in a manufacturing city of 25,000 inhabitants, who has got a big load of new power business for his company by use of the qualities I have mentioned. He goes into a factory, indicates, at the company's expense, the engines in use, figures out the energy saving he can effect by the use of motors, installed to the best advantage, finds out what its coal and water cost the factory, and has been enabled more than once to go in and win on a guarantee not to exceed for expense of operation these coal and water charges, getting eventually from four to six cents for the current. If the factory owners balk at the expense of motors, he offers to buy them and receive payment in instalments. If installation is going to interfere with the needed operation of machinery, he agrees to install the motors at night, on Sundays and holidays. That man has got ginger, and he does the business. He is now running not so very far away from that ideal condition where peak is nearly uniform for at least twelve hours per day. This man's example is a good one to follow.

There is one matter that your general agent and canvassers must not lose sight of. In the natural desire for new business, do not overlook or neglect old business.

As soon as the canvasser has signed up a customer the tendency is to quit him and pass by on the other side of the street. This must be avoided. The customer ought to be frequently visited by the man who took his contract, cementing an acquaintance, ascertaining and attending to his wants, and what is of the utmost importance in more ways than one, retaining his good will. If the customer has a complaint, it is better to relieve him of it than to let it rankle in his chest, and the complaint may be of something readily remedied. Besides, the customer may desire to add to his installation. Actually the old customers ought to constitute one of the most fruitful fields for new business. Don't neglect them.

The organization for getting new business outlined in the foregoing has the advantage of being elastic. If you require fewer canvassers than you at first figured upon, it is easy enough to lop them off; if you need more, to get them. I believe that if the ideas and plans of action suggested or described in this paper are followed with a reasonable degree of faithfulness and a proper adaptation to the peculiarities and exigencies of the particular central station making the trial, the result will be such a large volume of new business that, besides more canvassers within a year, you will require three additional members of your commercial staff, as follows:

A man to take hold of contracts as soon as they are signed and follow them up until connection is accomplished.

A secretary or assistant to the general agent, who shall attend to the mass of correspondence, and fulfil the office function of the general agent while he is engaged on the outside on new business propositions.

A record and filing clerk to handle the reports of canvassers, make out orders, and assume systematic charge of the papers and records of the department.

Erratum.—In the preceding section of this article, page twenty-seven, second column, six lines from the bottom, the clause reading "at other times using advertisement each week in dailies," should read "at other times using advertisement each week in weekly papers and about three times a week in dailies."

INDUSTRIAL SECTION.

ILLUSTRATED DESCRIPTIONS OF NEW AND STANDARD ELECTRICAL AND MECHANICAL APPARATUS.

New Hubbell Candelabra Socket.

The accompanying illustration shows the new candelabra socket manufactured by Harvey Hubbell, Incorporated, Bridgeport, Ct. No switch arm is needed when this socket is used. The standard length of chain on each socket is three inches. The sockets may be furnished, however, with chains of any length to suit require-

NEW CANDELABRA SOCKET.

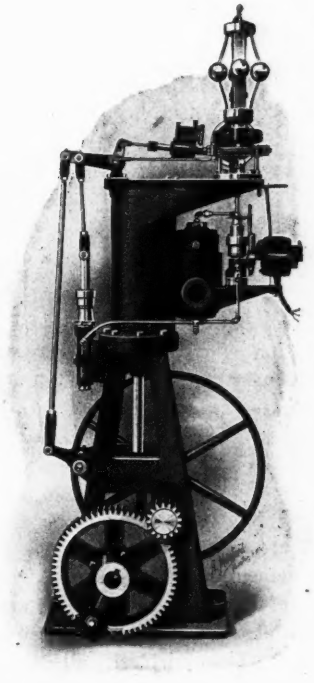
ments. This socket is very carefully constructed, having in mind the strains which are put upon the shell and the contact mechanism by reason of the pull on the cord. There is ample space between the contacts, the insulation has been very carefully worked out, and the socket is built rigidly and makes a very handsome appearance.

A New Water-Wheel Governor.

The speed regulation obtainable with the relay valve form of control, and the popularity of the type N vertical governor for water-wheel plants has led the Lombard Governor Company, of Ashland, Mass., to design a class of vertical governors having the same relay valve mechanism as the type N, differing from that machine principally in the relative position of the terminal shaft and main hydraulic cylinder.

These new governors are designated Type Q, the accompanying illustration showing the general appearance of the governor. At the present time they are made in two standard sizes, Q-6 developing 6,700 foot-pounds and Q-7½, 10,000 foot-pounds, being so much smaller than the Type N, which has a capacity of 31,000 foot-pounds, it is found desirable to put the terminal shaft near the ground with the power cylinder above. Maximum stability is thus obtained, while the controlling mechanism is brought to the most convenient height.

In Type Q governors, the hydraulic cylinder is cast of hard dense iron in one piece with the valve chamber and the support for the centrifugal balls. The base frame has the shaft bearings cast integral, so that the heavy stresses which are transmitted can not possibly cause displacement of any parts. The piston rod is drawn steel, the rack is forged and cut from open-hearth steel and the rack gear is cut from a solid steel bar. The terminal shaft is ground and has the rack gear shrunk on by heat. All relay and regulating valves have renewable parts of hardened steel. The centrifugal and anti-racing mechanisms are of standard form, with latest improvements. The hand-wheel device is



TYPE Q VERTICAL WATER-WHEEL GOVERNOR.

also of regular design, having a simple disconnecting clutch for the terminal shaft.

The sensitiveness of the governor may be increased or diminished at will, while it is in operation, by moving the micrometer cap of the regulating valve. The maximum speed of motion of the turbine gates may be varied through a wide range by the relay valve adjustment.

When safety permits, the Type Q governor may be adjusted to completely open or close the turbine gates within one second. Much slower action is easily obtainable; but it should be generally known that where hydraulic conditions permit, the speed regulation will be better in proportion as the governor moves quicker.

Type Q governors are provided with independent oil pumps of simple and reliable construction. These have cup-leather pistons which are very durable and may be renewed at slight expense. The valves and seats are of hardened steel. The tanks which are furnished are vertical and made of drawn steel. They are compound, containing a vacuum compartment above and a space for pressure below. Each governor has one of these tanks.

The "G. V." Pipe Cap.

The accompanying illustration shows the "G. V." pipe cap, manufactured by Gillette, Vibber & Company, New London, Ct. This cap is adaptable for covering the outdoor end of service pipe car-

"G. V." PIPE CAP.

rying any number of electrical wires. The caps are carried in stock from one-half to three inches, and may be used with either threaded or plain pipes. They are heavily galvanized to prevent corrosion, and are easily adapted to every condition.

Effect of Load-Factor on Fuel Consumption of Diesel Engines.

The curves on the accompanying diagram were plotted from data obtained from Diesel oil engine plants in regular operation covering a period of some months. They are of interest as showing the manner in which the fuel consumption (and therefore the cost of power) varies in remarkably close relation to the load-factor.

One characteristic of the ideal engine would be to have the cost per brake-horse-power-hour constant at all loads. If this

could be obtained the curve plotted from the data would be a horizontal, straight line.

In the combustion engine in which gas or vaporized oil is mixed with air and the mixture compressed and exploded, economy depends on a correct proportioning of the gas used with the air and the uniform compression of the mixture. The

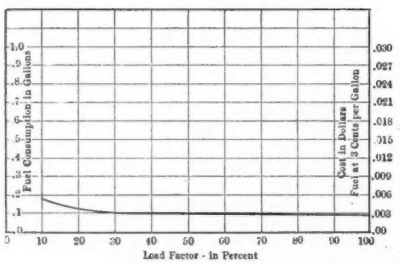


FIG. 1.—EFFECT OF LOAD-FACTORS ON DIESEL ENGINE ECONOMIZER.

allowable range of these proportions is very small for a given gas or oil. Should too much gas be admitted there will be insufficient oxygen present to support complete combustion and unburned gases will be exhausted and carbon deposited. If, on the other hand, too little gas is admitted the mixture will cease to be inflammable. And again, if governing be effected by varying the quantity of the mixture the compression will vary considerably, with great variation and loss of economy on light loads. It is evident, then, that a considerable increase in fuel consumption per horse-power-hour will be noted as the load-factor is decreased in combustion engines which govern by varying either the quality or quantity of the mixture.

The Diesel oil engine operates on principles which make possible the economy revealed by the fuel consumption and load-factor curve shown in Fig. 1. It operates on the four-stroke cycle principle, having one motor, or impulse, stroke in every four. Its cycle differs from the Otto, or common gas engine cycle, in that on the first, or admission, stroke the piston draws in a full cylinder of pure air instead of air and gas or vaporized oil. During the second stroke this pure air is compressed to such a high point that the temperature, due to compression, is sufficient to ignite any liquid fuel injected into it. This does away with all igniter systems.

At the end of the second stroke a charge of crude or fuel oil, distillates or even water-gas tar in a finely atomized state is injected into the intensely heated air, by a jet of highly compressed air from an auxiliary reservoir. The third, or power, stroke is taken up with the gradual burning of the fuel as fast as it enters the combustion chamber, and the expansion of the burned gases; while the fourth, or exhaust, stroke scavenges the cylinder.

The governor does not act to control the quality or quantity of a mixture, but acts on the oil pump of each cylinder, regulating the amount of oil injected into the cylinder at each power stroke. The supply of oxygen, even on full load, is more than sufficient to ensure complete combustion, thus preventing any loss of unburned fuel and the deposit of carbon on the cylinder or piston.

It will be noticed by reference to the curves that the fuel consumption and cost per horse-power-hour is low at full load, with a slight increase as the load-factor decreases. The curve not having any practical significance below a load-factor of about ten per cent, it was not extended beyond this point. The explanation of this economy may be found by reference to Fig. 2, which is a typical indicator card taken from a Diesel engine.

FIG. 2.—TYPICAL INDICATOR FOR DIESEL ENGINE.

It will be noted that the card resembles closely the ideal Carnot cycle. The compression starts on an isothermal—a line of constant temperature—following an adiabatic (a line of no transmission or reception of heat) at the higher pressures. What corresponds to the admission line of a steam engine is seen to be horizontal or slightly falling with no increase in pressure or temperature. It is therefore practically an isothermal. The expansion of the gases then follows, without addition of heat, in an almost perfect adiabatic. Thus virtually all the work stored in compression is given out on the power stroke with a minimum loss of heat to the cylinder walls and a minimum of internal friction.

As to speed regulations the Diesel engine is excellent, as the pistons receive no sudden impulses, back-firing is impossible, and the three cranks acting at angles of 120 degrees with each other maintain a constant torque on the crankshaft. It may be of interest to note that in several recent large installations Diesel oil engines are running alternators in parallel.

These engines are made by the American Diesel Engine Company, Indianapolis, Ind.

Yale & Towne Portable Electric Hoists.

Probably in no direction in the work of handling material has greater progress been made than in the design and construction of mechanical apparatus for eliminating large forces of laborers in transporting material from place to place. Particularly in warehouses and on wharves the portable electric hoist has achieved a remarkable development. The substitution of power for hand work is productive of very great economy, and because of the moderate investment of capital required, the low cost of operating and the facility for adaptation to existing conditions, the electric hoist is rapidly gaining in popularity.

When used in conjunction with a trolley, and on a system of tracks and switches, the uses to which the electric hoist may be put are almost numberless. The trolleys may be moved by pulling on the load, or where the load is considerable, the trolley can be furnished with gearing actuated by a hand chain. For longer distances the motor-driven trolley effects as great economy in horizontal transportation as does the electric hoist in vertical. An electric hoist equipped with a motor-driven trolley running on a system of tracks and switches, and with or without a simple cage for the operator, can be used to advantage in many places. As costly machinery and the lives of operators frequently depend upon the integrity of a hoist, the utmost care should be used in

FIG. 1.—SWIVEL FOR ELECTRIC HOIST.

designing it. With the Yale & Towne electric hoist, attention has been given to every part of the apparatus to ensure proper distribution of strains. Tensile

strains on cast metal have been carefully avoided.

All parts are made to gauge, thus securing complete interchangeability, and all electrical parts are tested to 2,200 volts.

The load is taken on wire rope of tough steel, wound on grooved drums of large size.

The Yale & Towne electric hoist will swivel a full turn in either direction, but where it is necessary for the hoist to swivel continuously, turntable collector rings can be supplied, as is shown in Fig. 1. The terminals pass into the top hook, and thence to insulated rings, as shown in the illustration. The hoist is equipped with either a plain controller having two speeds, and suitable for the majority of uses, or with a foundry controller for five speeds, and used where delicate handling of the load is necessary.

Pendant rods are generally supplied for operating the controller on all hoists up to and including fifteen-foot lifts. On higher lifts pendant cords are adopted.

The rod is telescoping, universal-jointed, swings in all directions, has a jointed T-handle to prevent catching on obstructions, and enables accurate handling of the load. The rod may be manipulated with one hand. The pendant cords are used where the hoist is required to traverse the length of the works over high obstructions.

The solenoid brake is shown in Fig. 2. By means of the solenoid brake, hoists can be controlled from a distant point, permitting the controller to be detached and mounted independently of the hoist at any convenient place.

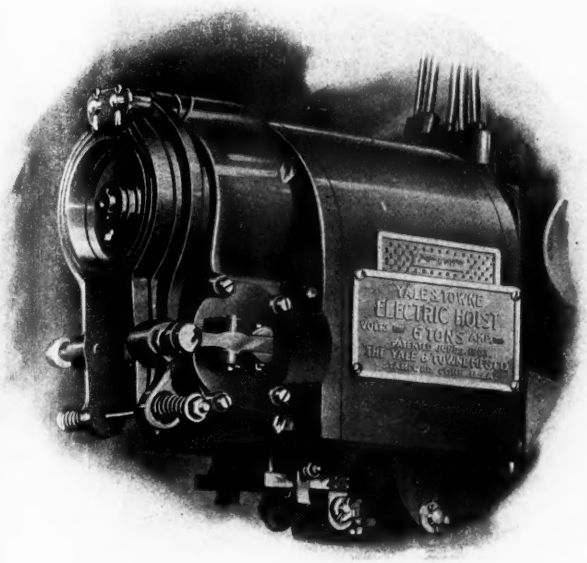


FIG. 2.—SOLENOID BRAKE FOR ELECTRIC HOIST.

A special feature of the Yale & Towne electric hoist is its single-point suspension. Hanging over a single hook, swiveling on ball bearings, it will swing in line with the direction of its lift. Its radius of action is thus increased.

Fig. 3 shows the hoist fitted with a chain in place of a wire rope. This type is desirable when the bottom block is exposed to much heat. As the chain is not wound on the drum like the rope, the height of the lift which this type of hoist can make is not limited.

The main office of the Yale & Towne company is 9-15 Murray street, New York city.

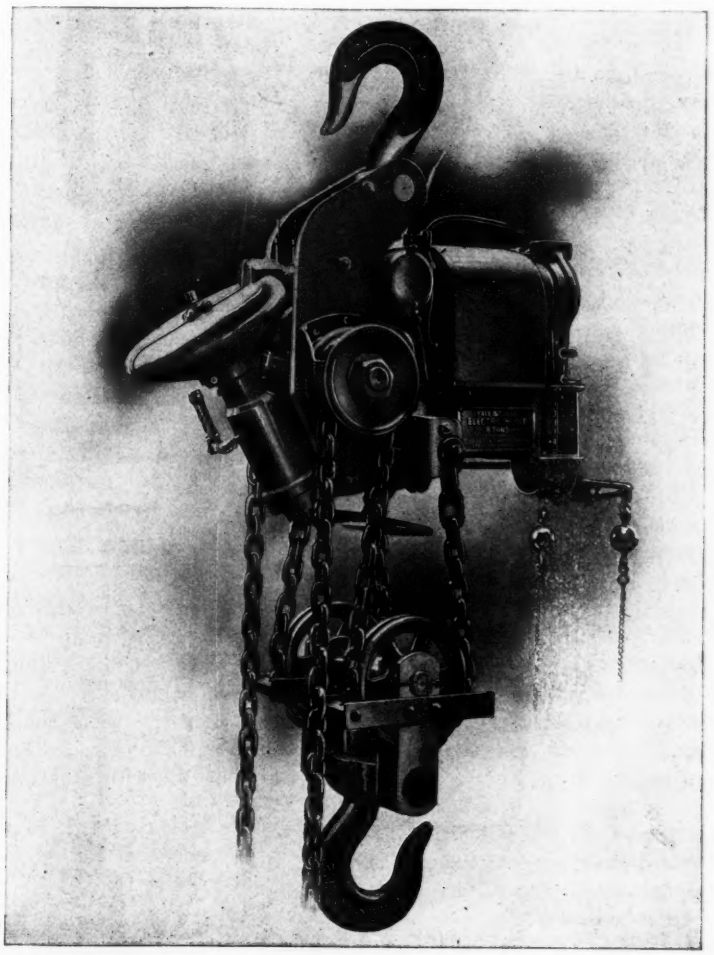


FIG. 3.—ELECTRIC HOIST FITTED WITH CHAIN.

New Outdoor Lighting Specialties.

The Ajax Line Material Company, Chicago, Ill., has been organized by Albert Scheible to design and manufacture an improved line of outdoor lighting specialties. Associated with him as secretary and treasurer of the company is John F. Turner, president and treasurer of the Sanitary Feather Company.

The president of the new company, Albert Scheible, graduated at the head of the original class at the Chicago Manual Training School. He took honors at Purdue University, and received a degree from Cornell. He spent a year at Cleveland as assistant to the superintendent of the Swan Lamp Manufacturing Company, and joined forces with George Cutter in Chicago in May, 1890, taking charge of the company's advertising, including devices for outdoor lighting, the prospects of which so impressed Mr. Scheible that he made this part of the general line his especial study, ultimately developing many ingenious and practical ideas in this direction. When the George Cutter Company was organized, Mr. Scheible was made secretary and treasurer, which position he held until he sold his interest a few months ago. The Ajax Line Material Company has leased an entire floor of the building at 12 and 14 South Jefferson street, where it will manufacture improved forms of outdoor lighting specialties originally designed by Mr. Scheible, together with the new types which are being brought out under his own patents.

Electrical Machinery in South America.

The growing use of electrical machinery in South America is illustrated in the following notes. The Empresa Electrica de Santa Rosa, Peru, which already operates a large generating station on the River Rimac, is extending its service to such a degree that an additional powerhouse is necessary. This will be operated in parallel with the present station. The equipment for the new station has been ordered from the General Electric Company, Schenectady, N. Y. It includes two three-phase, sixty-cycle, revolving-field, alternating-current generators, each rated at 1,200 kilowatts and operating at 2,300 volts. The generator voltage will be stepped up in three 750-kilowatt water-cooled transformers to 33,500 volts, and transmitted to a substation where distribution will be made from water-cooled step-down transformers at 2,300 volts. The order also includes switchboards and auxiliary apparatus.

In Brazil the Sao Paulo Tramway, Light and Power Company is also making additions to its present equipment. At the generating station another General Electric three-phase, revolving-field, 2,000-kilowatt, 2,300-volt generator is about to be installed with necessary switchboards for the operation of the new machine. In addition, the equipment will be increased by three sixty-cycle, 666-kilowatt, 24,000/-2,000-volt transformers and three sixty-cycle, 666-kilowatt, 20,000/2,300-volt transformers of the same type. The railway equipment is being increased by ten double-motor car equipments, and one four-motor equipment. This machinery also has been ordered from the General Electric Company.

Another interesting installation about to be made in Peru is at the mines of the Inca Mining Company. The location of the properties of this concern makes transportation very difficult, and all material has to be packed up the mountain trails on mules. The electrical equipment includes a General Electric three-phase, 200-kilowatt, 6,600-volt alternating-current generator of the revolving field type. In addition, there will be four sixty-seven-kilowatt transformers as well as several induction motors for hoisting work and the necessary switchboards, also furnished by the same company. In order to facilitate transportation all the apparatus will be constructed in parts, none of which will weigh over 350 pounds, except the alternator shaft. The work of assembling the machinery will be done at the mines.

"Keough" Cord-Grips.

The accompanying illustrations show two cord-grips made by Keough Brothers & Company, 79 North street, Boston, Mass. Fig. 1 shows the cord-grip handle for use with reenforced cord and for a one-eighth-

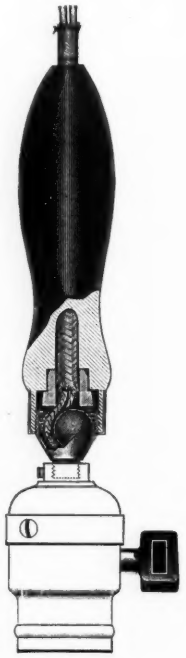


FIG. 1.—CORD-GRIP HANDLE.

inch socket. This is strongly built, and the grip holds the cord so that there is no chance of its being pulled away from the terminals. Fig. 2 illustrates the cord-grip for use with show-windows or reen-

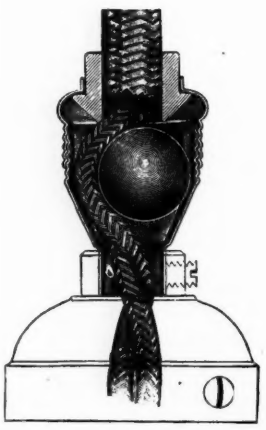


FIG. 2.—"KEOUGH" CORD-GRIP.

forced cord. This grip also permits a one-eighth-inch socket to be used with the largest size of cord.

The method of gripping the cord is clearly shown in the illustrations. It is accomplished by means of a ball placed in a somewhat tapering receptacle. In this way both strands of the cord are tightly held, and there is no danger of cutting or piercing the insulation. Although the device attaches to small sockets, any size of cord may be used, and all will be held equally secure. It does away with the somewhat undesirable practice of tying a knot in the cord in order to remove the strain from the terminal screws. Moreover, if this cord-grip be adopted, the contractor is not compelled to carry two sizes of sockets in stock, for the one fixture permits the use of large and small cords.

Second Annual Conference of the Franklin Electric Manufacturing Company.

The Franklin Electric Manufacturing Company, Hartford, Ct., held the second annual conference of its manufacturing and sales departments during the week beginning June 25. On Monday an enjoyable smoker was held at 8.30 in the evening. Tuesday morning and afternoon were given up to conferences at the factory, the evening to an excursion to Hartford Luna Park. Wednesday morning was taken up in conference, and the afternoon by the annual baseball game. Thursday conferences were held in the morning and in the afternoon. In the evening the annual dinner was given at the Farmington Country Club. An excellent menu had been provided, and practically all the officers and representatives of the company attended. The final conference was held on Friday morning. In the afternoon a party left for New York by boat and spent Saturday at Manhattan Beach.

The Franklin company has found that a great deal of good was accomplished at the conference held last year, and judging from the success of the present one, anticipates still more benefit.

Production of Asbestos in 1905.

A bulletin from the United States Geological Survey states that the output of asbestos in the United States for 1905 was 3,109 short tons, valued at $42,975. This exceeds the production of any previous year, both in tonnage and value, and represents an increase of more than 100 per cent in quantity and of about sixty-seven per cent in value over the output for 1904. Georgia, Virginia and Massachusetts produced 2,995 tons of this material, the remainder coming from California, Michigan and Wyoming. The increased output was due principally to Georgia and Virginia.

A New Line of Stanley-G. I. Arc Lamps.

A new line of arc lamps has been put upon the market by the Stanley-G. I. Electric Manufacturing Company, Pittsfield, Mass. These lamps were designed some time ago, and several thousands of them have been in service for about a year, so that the good qualities of the design are now known. This line, which is designated as the type "K," includes direct lamps for voltages from 100 to 125, and from 200 to 250.

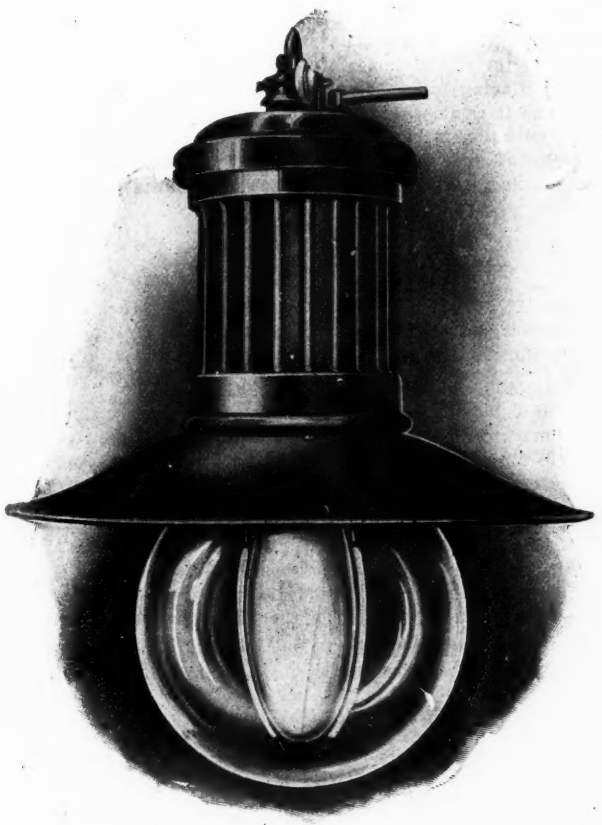


FIG. 1.—OUTDOOR TYPE "K" LAMP.

The general appearance of the lamps is shown in the accompanying illustration (Fig. 1), which is from a photograph of a lamp designed for outside use. In this particular lamp a great deal of attention has been paid to the selection of the glassware, and the combination shown includes an opal inner globe surrounded by a clear outer globe, and the latter surmounted by an enameled reflector, which has been found to give excellent distribution of the light. When the lamp is used for interior lighting this reflector may be removed and the clear outer globe replaced by an opal outer, which gives a very soft, pleasant light. All of these globes and reflectors have been carefully designed, with a view to obtaining the most effective distribution of light, for upon this factor depend largely the satisfactory results of any system of illumination.

The shells of these lamps are made of either copper or steel, and are given a number of finishes. The copper shells are either mottled or oxidized black, and the steel shells are furnished either with a dull or bright black enamel, or with the two copper finishes, the last two being obtained by electroplating upon steel. The company, however, recommends that copper shells be used for lamps intended for outdoor service. The tops of the lamps are made from one-eighth-inch thick, cold rolled sheet steel, finished in dull black. When copper shells are used a ring covers the top, making the finish match the shell.

Fig. 2 shows the simplicity of the type "K-31" lamp, the style employed for multiple direct-current systems. It will be noted that there is no inflammable material employed here. The insulation of the flexible leads is formed of glass beads, and the resistances, which are four in number, are wound on porcelain. The design of this lamp makes the centre tube unnecessary, and only one lead is required. A simple and reliable clutch is employed, and all parts are designed to be easily replaced. The resistances can be taken out separately or in sets and replaced by new ones in a few moments. All that is required is the removal of two clips. The regulating magnet is wound with specially treated wire, rendering it practically indestructible.

The lamp just described is intended for five amperes and any voltage from 100 to 125. The style "K-41," which resembles closely the one just described, has five resistance coils, and can be adjusted to any current value ranging from three to six amperes, and any voltage from 100 to 125. A third style, designated as "K-22," is identical in mechanical construction with the regular direct-current, 110-volt, type "K-31" lamp, but it is provided with six resistance bobbins, enabling it to be used on any line voltage from 200 to 250. Adjustment is easily made by means of movable clips on the bobbins. In this lamp the magnet spool also can be removed easily and replaced by one intended for 110 volts, thus converting it into a type "K-31" lamp.

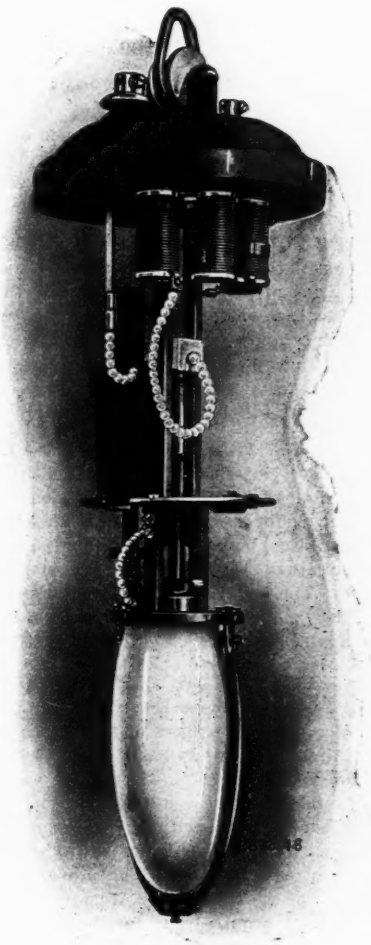


FIG. 2.—SHOWING MECHANISM "K-31" LAMP.

The Importation of Asbestos.

The importation of asbestos into this country increased in 1905. In value it amounted to $845,479, as compared with $751,862 in 1904. Most of this asbestos is imported from Canada, as this country takes approximately two-thirds of the Canadian output. In 1905 Canada produced 50,670 tons. This was valued at $1,486,359. The principal countries for producing asbestos, in addition to that mentioned, are Italy, Russia, Australia and South Africa.

CURRENT ELECTRICAL NEWS

DOMESTIC AND EXPORT.

LARGE BOND ISSUE—The New Castle & Harmony Street Railway Company, which proposes to build a road from Pittsburg to New Castle, Pa., *via* the Ohio river, has arranged for a bond issue of $3,500,000 with the Union Trust Company, of Pittsburg, as trustee. The latter company will also underwrite the issue.

POWER COMPANY CHANGES HANDS—The International Power and Transmission Company, of Niagara Falls, capitalized at $2,000,000, has passed into the hands of Lockport capitalists. The company was organized by S. P. Franchot, J. S. Simmons, F. J. Brown, James H. Lynch and Findlay & Tower, and was later acquired by the Niagara, Lockport & Ontario Power Company.

NEW POWER COMPANY FOR LOCKPORT, N. Y.—The formal transfer of the heating plant of the American District Steam Company, Lockport, N. Y., to the Economy Light, Fuel and Power Company has been made, and the latter company is now actively engaged in getting ready to supply Lockport with electricity by October 1, for lighting and power purposes. Workmen are engaged in razing the old machine shop and boiler-house of the steam company, and a new plant will be constructed, entirely of steel and brick.

NEW ST. LAWRENCE POWER PLANT PROPOSED—H. H. Warren, of Massena, N. Y., and Smith L. Dawley, of Ogdensburg, have made application for permission to construct a power canal in Long Sault channel in the St. Lawrence river. It is planned to develop a maximum of 25,000 horse-power, which would necessitate the building of a dyke along the northerly shore of Long Sault island. The estimated cost of the system is $1,500,000. A meeting will be held in Toronto on July 24, when the International Waterways Commission will consider the matter.

POTOMAC ELECTRIC POWER COMPANY FILES DEED OF TRUST—The Potomac Electric Power Company has filed with the recorder of deeds a deed of trust upon all its property rights and franchises to secure an issue of $7,000,000 in bonds. The bonds are of the denomination of $1,000 each and are payable July 1, 1936, with interest at five per cent. The object of the issue, it is stated, is to furnish funds with which to purchase additional real estate, construct a new power-house and otherwise better the condition of the company's property. The property pledged consists of all the holdings of the company in Washington and Georgetown, as well as the recently acquired site for the new power-house on the Benning road. The Commercial Trust Company, of New Jersey, is the trustee named in the mortgage.

CHICAGO TRACTION RECEIVERS—Application has been made in the United States Circuit Court by counsel for the Guaranty Trust Company, of New York, for the appointment of receivers to take over the combined properties of the Chicago Union Traction Company, the North Chicago Street Railway Company and the West Chicago Street Railway Company. The application is made in an amended and supplemental bill, which is to take the place of the original bill of complaint upon which receivers were appointed separately for the three companies some time ago. The desire for the administration of the three companies by one set of receivers is due to the necessity of lowering the tunnels and supplying electrical power for the various cable lines. It will mean, should the petition be granted, that the present receivers administering the properties separately will be removed and some, if not all, reappointed as receivers for the combined lines.

APPLICATION OF ELECTRIC LINES COMPANY DENIED—Supreme Court Justice Bischoff has denied the application made by the New York Electric Lines Company for permission to construct conduits throughout the city of New York. In so deciding Justice Bischoff approves the stand taken by Commissioner Ellison of the water supply, gas and electricity department, who denied the company's requests for permits to open streets for the construction of conduits in which to lay telephone and other electric wires. Justice Bischoff holds that the company lost its right to open streets by the action of the legislature of 1885 in passing the subway act. The company got its franchise in 1883, and actually began work within the following year. By the subway act it got sixty days within which to assert its right to construct subways independently of the commissioner of public works or other municipal authority. Having failed to so assert its rights within that prescribed time it came within the provision of the law, and as the present application is based merely upon the company's franchise Justice Bischoff finds that there is no apparent reason for overturning the existing legislation, under which the company has lost its rights.

ENGINEERING SOCIETIES.

AMERICAN ELECTROCHEMICAL SOCIETY—The American Electrochemical Society will hold its tenth general meeting in New York city during October, 1906.

ILLUMINATING ENGINEERING SOCIETY—The first three numbers of Volume I of the transactions of the illuminating Engineering Society have been issued. These contain, respectively, the papers and discussions of the February, March and April meetings of the society.

SEATTLE BRANCH, AMERICAN INSTITUTE OF ELECTRICAL ENGINEERS—The Seattle (Wash.) branch of the American Institute of Electrical Engineers made a trip to British Columbia, June 9 to 11. The trip included a visit to the hydroelectric plant and street railway system of the Vancouver Power Company and an inspection of the 23,000-volt transmission line at Burrard inlet.

NEW PUBLICATIONS.

A 10,000-HORSE-POWER SINGLE-WHEEL TURBINE—Arthur Giesler has published, in pamphlet form, a reprint of his article entitled "A 10,000-Horse-Power Single-Wheel Turbine at Snoqualmie Falls, Wash.," which appeared in the *Engineering News*.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS—Vol. XXVI of the transactions of the American Society of Mechanical Engineers contains papers and discussions of the fiftieth meeting held at New York in 1904, and the fifty-first meeting held at Scranton, Pa., in 1905.

NOTES ON POWER GENERATION IN IOWA—A bulletin recently issued by the Iowa State College Experiment Station deals with the Iowa coal fields and describes the quality of these coals and their calorific value. Results are given also of tests made of this coal for use in gas producers and in raising steam.

NEW MANUFACTURING COMPANIES.

TRENTON, N. J.—The Electric Service Supplies Company has been incorporated with a capital of $450,000, to deal in electrical and mechanical apparatus and supplies. The incorporators are: Edwin B. Ross, John McSorley and A. H. Englund.

ATTLEBORO, MASS.—Incorporation papers have been filed of the A. R. Macomber Company, manufacturer of electrical supplies, and to engage in electrical construction and general electrical work. The company has been organized with a capital stock of $10,000. A. R. Macomber is president and treasurer, John E. Wilmarth, of Taunton, clerk, and Elwood F. Macomber, of Swansea, is vice-president. The company will absorb the business formerly conducted by A. R. Macomber.

TELEPHONE AND TELEGRAPH.

BEATRICE, NEB.—The Bell Telephone Company has a force of men at Wymore rebuilding its system there.

BEATRICE, NEB.—Work has been started on a new telephone plant at Wymore by the Nebraska Telephone Company, to cost about $23,000.

DARIEN, N. Y.—The Darien Telephone Company has entered upon a contract for long-distance service with the Inter-Ocean Telephone Company.

MINNEAPOLIS, MINN.—The Northwestern Telephone Exchange Company is now engaged in reconstructing a number of its pole lines in various parts of Minneapolis.

PLAINFIELD, N. J.—The New York & New Jersey Telephone Company is building a new line from Bound Brook to Pluckamin, all of the rights of way having been secured.

LITTLE ROCK, ARK.—An amendment to its articles of incorporation has been filed by the Automatic Home Telephone Company, of Jonesboro, increasing the capital stock from $25,000 to $100,000.

SANDPOINT, WASH.—The Rocky Mountain Bell Telephone Company will proceed with the building of toll lines to Bonners Ferry and Hope. It will also install a new line between Rathdrum and Coeur d'Alene.

GUTHRIE, OKLA.—The Pioneer Telephone Company, with headquarters at Guthrie, has purchased the Independent exchange at Cleveland for $11,500. The Pioneer controls practically all the telephone business in the two territories.

BURLINGTON, IOWA—The contract for a new building for the Bell Telephone Company has been awarded to the Concrete Construction Company, of Rock Island, Ill. The new building will cost about $16,000, to be completed by the middle of October.

NEW WESTMINSTER, BRITISH COLUMBIA—The British Columbia Telephone Company is about to lay a new cable across the Fraser river. It will be 2,500 feet long, and is for the further improvement of the Chilliwack, Blaine and Ladner service.

BELLINGHAM, WASH.—The Home Telephone Company has let a contract for the preliminary work on the new exchange building. Excavation work will be commenced at once. The management expects that the greater part of the summer will be required to get the system completed.

TECUMSEH, NEB.—At a meeting of the stockholders of the Johnson County Home Telephone Company it was decided to double the capital stock of the organization. It is now $50,000 and will be made $100,000. The funds will be used in establishing a complete county service.

TOLEDO, OHIO—At a special meeting of the directors of the American District Telegraph Company, the company was reorganized, and the following directors elected: Mrs. Carrie McNamar, Charles S. Northup, Dr. John S. Pyle, Clarence Brown, L. T. Williams and Martin J. Carney.

BINGHAMTON, N. Y.—Certificates of incorporation of the East Richford Telephone Company and the East Berkshire Telephone Company have been filed with the county clerk. The line of the Richford company will extend from Lisle to Richfield and the other line will run from Lisle to Berkshire.

LAS VEGAS, N. M.—The Colorado Telephone Company has closed a deal for the franchise, telephone system and property of the Las Vegas Telephone Company. The price which the Colorado company will pay is $18,000, the property to be transferred January 1, 1907. The Colorado company will extend the lines and service.

LINCOLN, NEB.—The capital stock of the Fillmore County Telephone Company has been increased to $100,000. Of this amount $60,000 is to be preferred stock, bearing interest at the rate of ten per cent, payable semi-annually. The directors of the company are: M. Bolton, John Barsby, E. K. Cobb, A. G. McGreevy and G. E. Beaman.

CHESTER, PA.—The Delaware & Atlantic Telephone Company has a large section of its conduits laid through Chester, and it is expected that connections will be made with both the Delaware and Philadelphia sections early in the fall. The conduits between Darby and Wilmington, including the direct system through Chester, will put more than 100 miles of wire under ground.

CHICKASHA, I. T.—The residents of the district between Pocasset and Dutton are forming local companies for the erection of telephone lines with the expectation of consolidating the local companies into one larger organization, taking in some 200 telephones. The line will run through Pocasset and thence to Chickasha, where it is proposed to establish a central office.

DILLON, MONT.—The Southern Montana Telephone Company will greatly extend its system in the Big Hole basin, building about 200 miles of line and adding 100 new telephones. An extra line will connect Jackson and Wisdom, and the main offices will be at these two places. Work will be started on the extensions as soon as material and supplies can be secured, and the company expects to have all the lines completed within two months.

STILLWATER, MINN.—The Northwestern Telephone Company is making extensive additions to its system connecting with the exchange in Stillwater. A force of men has almost completed a two-circuit addition direct to Minneapolis. Crews are at work on additions as follows: a three-circuit system to the lake Elmo region, a two-circuit system to the Square lake region, an addition to the Houlton (Wis.) service, a two-circuit system in the town of Grant and a circuit to the Big lake country.

NEW YORK, N. Y.—Plans have been filed for remodelling the six-story Gramercy exchange of the New York Telephone Company at Irving place and Eighteenth street. The improvements include the making over of the ground and second floors, which were formerly the offices of the Tenement-House Department. The old entrance on Eighteenth street is to be removed and an ornamental window installed in the place. The changes are to cost $23,000. The architects are Eidlitz & McKenzie.

YUBA CITY, CAL.—Dr. E. V. Jacobs, of Meridian, representing capitalists, has made application for the privilege of maintaining and operating a telephone system through Sutter county. The franchise is to run for fifty years from date of its authorization, and the grantee of the franchise is to deposit a $500 bond that the conditions of such franchise will be truly and fully kept and maintained according to agreement. Four months' time is to be given after the franchise is granted in which to commence work, which must be completed within three years.

MONTREAL, QUEBEC—With the stringing of an additional copper wire from Winnipeg to Montreal, five through wires are now in service over the Canadian Pacific Railroad telegraph system. One of the five is a direct wire between Vancouver and Montreal. Construction has been very heavy for several years past, but this year will be largely in excess of previous years. About 850 miles of pole line will be constructed, over half of which will be along new lines of railway. A line will also be constructed between Vancouver and Revelstoke, the length being about 360 miles.

DENVER, COL.—The Northwestern Telephone Company has been organized to operate in Boulder, Routt, Larimer, Arapahoe and Denver counties. Headquarters will be at Longmont. The capital stock is placed at $50,000. The incorporators are: M. H. Spere, J. K. Brown, E. V. Bowles, J. A. McCollister and W. W. McCollister. It is the intention of the company to string telephone wires into Steamboat Springs and Hayden in Routt county, and work will be begun at once. All of the principal towns along the line of the Colorado & Southern Railroad in northern Colorado will be on the lines of this system.

WASHINGTON, D. C.—Preparations are being made by the war department for the extension of the Alaska cable, $179,000 having been made available for the purpose by a recent act of congress. It is proposed to attach the branch to the loop between Juneau and Sitka in Frederick sound, extend the line to Petersburg, thence to Wrangell, thence to Hadley and thence to Ketchikan. Plans are also nearing completion for installing duplexing machines in connection with the Alaska cable. This will increase the capacity of the line by about seventy-five per cent. The net receipts of the Alaska telegraph system in May broke all records since the installation of the telegraph in the territory, and the cable is crowded with commercial business. The May receipts were $21,300, which is said by the war department to be the largest net amount on record.

ELECTRIC RAILWAYS.

PORTLAND, ORE—Active preparations are now in progress for the resumption of work on the Salem-Portland electric road, which was suspended some time ago.

WHEELING, W. VA.—The Belmont county commissioners have granted a franchise for the extension of the Wheeling traction lines from Bellaire to Shadyside.

SEDALIA, MO.—The property of the Sedalia Railway and Electric Company, of Sedalia, Mo., has been sold to Edward M. Deane & Company, of Grand Rapids, Mich.

DETROIT, MICH.—The electric railway line, planned to run from Detroit to Lansing, by way of Plymouth, Brighton and Howell, will be in operation by January 1, 1907.

GOSHEN, IND.—The Winona assembly has formally opened its trolley line from Warsaw to Goshen. The Warsaw-Peru line, also owned by the assembly, will be opened November 1.

WARREN, OHIO—A contract has been entered into by the Eastern Ohio and the Mahoning & Shenango Valley roads for the construction of a line from Leavittsburg to Chagrin Falls.

RED BANK, N. J.—The Monmouth county board of freeholders has granted a franchise to the Monmouth Electric Company, permitting it to build an electric railroad along the public road from Red Bank to East Oceanic.

MENOMONIE, WIS.—A survey is being made from Eau Claire to Menomonie by the Chippewa Valley Electric Railway Company with a view to determining the feasibility of extending its trolley line to the latter city.

PHILADELPHIA, PA.—Work on the proposed trolley line from Newtown to Hatboro will be begun within the next few weeks. All rights-of-way have been granted for the upper route, which crosses the Neshaminy at Richboro.

SUFFOLK, VA.—After being discussed for several months, the street railway franchise has been adopted by the Suffolk council. This insures local trolleys and interurban service between Suffolk and Norfolk. The lines will be run by the Norfolk & Portsmouth Traction Company.

BALTIMORE, MD.—The second branch of the city council has passed finally the ordinance granting a twenty-five-year franchise, renewable for another twenty-five years, on the St. Paul street, Merryman's lane boulevard, to the United Railways and Electric Company's subsidiary concern, the Maryland Electric Company.

TROY, N. Y.—The contract for building the electric road from the Massachusetts state line to Bennington, Vt., has been awarded by the Consolidated company, which controls the franchise. The road will be finished not later than December 1, and will give a line into North Adams. About $500,000 will be spent in building and equipping the road.

NEW YORK, N. Y.—At a conference between the state railroad commissioners, Borough President Haffen and President Maher, of the Union Railway Company, the railway agreed to begin work at once to put the Broadway and Kingsbridge line in condition for the operation of cars. The work is to be completed by August 1. It will then be possible to go from the Battery to Yonkers, *via* the Union Railway, for ten cents.

BIRMINGHAM, ALA.—The Birmingham Railway, Light and Power Company has made public improvement plans that call for the expenditure of hundreds of thousands of dollars on the street railway system of Birmingham and the district. Four of the present lines will be double-tracked, a new line will be built to Avondale, another to South Highlands, and a network of tracks will be built in the vicinity of the new union passenger station.

JANESVILLE, WIS.—A new independent movement to build an interurban railroad from Janesville to Madison has been launched by local business men, headed by H. H. Clough, of Elyria, Ohio, former superintendent of the Rockford, Beloit & Janesville line. The project contemplates the securing of a fifty-year franchise with liberal freight-carrying privileges, and it is expected that the actual work of building will be commenced before the fall.

CINCINNATI, OHIO—The Cincinnati, Milford & Loveland Traction Company has inaugurated a regular passenger service over the extension of the line that has been built from Milford to Blanchester in Clinton county. Blanchester is about forty miles east of Cincinnati. The new road that has just been completed between that city and Milford is twenty-five miles long. The extension will bring a rich farming section in close touch with Cincinnati.

TOLEDO, OHIO—The Toledo Railway and Light Company is spending about $700,000 on improvements and extension. A large new power-house as well as a union electric station are under construction, while a line fifteen miles out of Toledo is now nearing completion to Ottawa Beach. All three lines, Detroit, Toledo, and Northern Ohio Traction, are benefiting very much by the development of the interurban business, and there is a steady increase in the electric business from Cleveland to Detroit through Toledo.

DANBURY, CT.—Governor Higgins, of New York, has signed a bill extending to January 1, 1907, the time for the completion of the interstate trolley line which the Danbury & Harlem Traction Company is building from Danbury to Goldens Bridge, N. Y. Part of the road has been constructed from Danbury to North Salem, N. Y., but west of that point practically nothing has yet been done. The officers say that the cars will be in operation between Danbury and North Salem in July. The work of equipping the power plant will shortly be undertaken.

GOSHEN, IND.—It is announced that work on the Indianapolis, Huntington, Columbia City & Northwestern Electric Railway will be begun in Goshen within thirty days. The construction contract has been let to Ryan Brothers, of New York. The capital stock of the company has been increased from $50,000 to $1,500,000. Most of the stockholders are wealthy men living in the section through which the road is to pass. As surveyed, the line will connect Goshen with Syracuse (Lake Wawasee), Churubusco, Columbia City, Huntington, Portland and Indianapolis.

DES MOINES, IOWA—Richard R. Rollins, president of the Des Moines-Indianola Interurban Company, says that grading for the road will probably start in about thirty days. It is the plan now to build south from Fort Des Moines, a distance of twelve or fourteen miles, and to use the Fort Des Moines line into the city. The maximum grade will be one and one-half per cent. The plan of extending the line from Indianola to Chariton, Corydon and Centerville is being considered. At Chariton it would cross the main line of the Burlington, a distance of some thirty miles from Indianola.

PITTSBURG, PA.—The Bessemer Contracting and Ballast Company, of Pittsburg, has been awarded the contract by the Pittsburg, McKeesport & Connellsville Railway Company for the grading and masonry work on the new traction line to be built from Lecterone to Masontown, Pa. The contract includes the work on four and one-half miles of single track. It will be necessary to construct five bridges on the line, which has its right-of-way entirely through private property. Upon the completion of this line the Pittsburg & Western Railways Company will have direct connection with traction lines from Pittsburg to Masontown.

PITTSBURG, PA.—Announcement has been made of the sale of the Pittsburg & Allegheny Valley Street Railway Company to M. K. McMullin. The purchase price was reported as being $2,000,000. When the company was organized a bond issue of $1,100,000 was provided to construct the entire road of twenty-five miles. But eight miles are built at this time. The line now extends from Apollo to Leechburg, and it is proposed to extend it to New Kensington and Parnassus. This will permit it, by means of a short branch, to connect with the Verona line of the Pittsburg Railways Company. O. W. Kennedy was the former president and Colonel F. M. Jackson, treasurer of the company.

CARTHAGE, MO.—R. C. Rawlins, of Chanute, Kan., who is promoting the proposed Missouri-Kansas electric railroad, has completed arrangements for the road. He states that the money has already been subscribed by St. Louis and Philadelphia capitalists, and actual work will begin in several places within a month. It is proposed to start building from both Coffeyville and Chanute, the two lines converging at Parsons and then running direct to Carthage, taking in Webb City, Joplin and other cities and towns in the zinc-mining district. The company will furnish service on a thirty-minute schedule between Carthage and Joplin, and fifty minutes between Carthage and Galena, Kan. Sixty-foot cars will be used for the interurban traffic and forty-foot cars in the towns.

PERSONAL MENTION.

MR. J. J. GHEGAN, president of J. H. Bunnell & Company, has been spending several weeks in Europe, enjoying a tour and rest in that country. Mr. Ghegan expects to return to New York the latter part of this month.

MR. GEORGE A. McKINLOCK, president of the Central Electric Company, Chicago, passed through New York last week *en route* for Europe, where he will spend six weeks in touring the Continent in an automobile of the latest design.

MR. HERBERT G. WILLIAMS, for some years superintendent of the Port Chester (N. Y.) branch of the Westchester Lighting Company, has resigned to assume the management of the Schuylkill Light and Traction Company, Philadelphia, Pa.

MR. DAVID GAEHR, Cleveland, Ohio, who opened offices about one month ago at 1201 Schofield Building as an agency for the C & C Electric Company, Garwood, N. J., manufacturer of dynamos and motors, reports an especially successful commencement of his work.

MR. EDGAR C. BRADLEY, for fifteen years past a prominent official of the Postal Telegraph-Cable Company, resigned as vice-president last week with a view to entering other business. Mr. Bradley is one of the foremost telegraph men of the country and is energetic, broad-gauged and tactful. He will carry with him into his new field the best wishes of a large number of friends.

DR. RICHARD TETLEY GLAZEBROOK, the president-elect of the Institution of Electrical Engineers, of Great Britain, was born in Liverpool, September 18, 1854. He was educated at Liverpool College and Trinity College, Cambridge, graduating in 1876 with the degree of B. A., and being Fifth Wrangler. He commenced the study of physics under Clerk Maxwell at the Cavendish Laboratory, and at the death of the latter in 1880 was appointed demonstrator there. Later he was made a lecturer and assistant tutor of his college, and assistant director of the Cavendish Laboratory under Professor J. J. Thomson, holding the latter position until, in 1898, he was appointed principal of University College, Liverpool. Shortly after the latter appointment he was made director of the National Physical Laboratory, taking up his work there in 1900. This position he still holds. Dr. Glazebrook is a frequent contributor to the scientific journals, and is the author of numerous textbooks on physics. He is a Fellow of the Royal Society, a past-president of the Physical Society, and holds the honorary degree of doctor of science.

MR. CHARLES P. BRUCH, formerly assistant secretary and assistant general manager of the Postal Telegraph-Cable Company, has been elected one of the vice-presidents of this company, and assumed office the first of July. This is a very proper recognition of long and intelligent service as a member of the staff of the Postal company. Mr. Bruch was born in Louisville, Ky., in 1860. When he was eighteen years of age he entered the employ of the Western Union company at Canton, Ohio, as a student. Coming to New York in November of the same year he entered the New York office of the company, finally being placed in charge of the complaint bureau of the operating room. In 1883 Mr. Bruch resigned his position with the Western Union company to become clerk of the Telegraphers' Mutual Benefit Association, and was made secretary of this organization in November of the same year. At the end of five years Mr. Bruch took charge of the office of the Edison Phonograph Company. In 1891 he was made assistant to the vice-president of the Postal Telegraph-Cable Company, and was elected assistant secretary and assistant general manager on January 1, 1893. Mr. Bruch has a wide circle of friends. He is the fortunate possessor of a nature that is not easily ruffled, and carries through important executive work easily and efficiently.

MR. CHARLES P. BRUCH.

OBITUARY NOTICES.

MR. GEORGE FARRELL, chief operator of the Fire-Alarm Telegraph Bureau at fire headquarters, New York city, died at his home, 155 East Eightieth street, on June 30. Mr. Farrell was fifty-eight years old, and has been connected with the fire department since 1873.

MR. JOHN E. McDONALD met his death in the train wreck at Salisbury, England, July 1. Mr. McDonald was for a number of years connected with the firm of W. & J. Sloane, New York city, but later interested himself in telephone and real estate enterprises, becoming president of the New York Telephone and Telegraph Company, of the Knickerbocker Telephone and Telegraph Company and of the Thomson Hill Land and Improvement Company, and treasurer of the Massachusetts Telephone and Telegraph Company and of the Telephone, Telegraph and Cable Company of America. Mr. McDonald was thirty-eight years of age and resided at 216 West Seventy-second street, New York city. He leaves a widow.

LEGAL NOTE.

SERIES-PARALLEL CONTROLLER LITIGATION—In the United States Circuit Court of Appeals for the Third Circuit, sitting in Philadelphia, Pa., a decision was handed down on June 11 in favor of the General Electric Company against the Garrett Coal Company, alleging the use of series-parallel controllers manufactured by the Morgan-Gardner Company, Chicago, Ill. These controllers, it was alleged, were an infringement of the plaintiff's patents Nos. 587,441 and 587,442, August 3, 1897.

NEW INCORPORATIONS.

CHESTER, PA.—Upper Darby Light, Heat and Power Company, of Upper Darby. $5,000.

ALLENTOWN, PA.—South Bethlehem Street Railway Company, of South Bethlehem. $42,000. President, Charles P. Hoffman.

MADISON, WIS.—Wisconsin Metropolitan Telephone Company. $100,000. Incorporators: John A. Wallis, Louis N. Brown and August C. Moeller.

FLINT, MICH.—Oak Park Power Company. $60,000. Incorporators: William G. Doolittle and C. S. Mott, of Utica, N. Y., and Charles M. Begole, of Flint.

GUTHRIE, OKLA.—The Carmen Electric Light and Power Company, of Carmen. $12,000. Incorporators: J. F. and S. A. Mott, of Carmen, and Z. B. Bird, of Enid.

CHATTANOOGA, TENN.—Jackson Railway and Light Company, of Madison county. $600,000. Incorporators: S. S. Bush, Atilla Cox, Jr., Alan MacDonald, John Wisdom and Charles D. Lehmkuhl.

HARRISBURG, PA.—People's Electric Light Company, Lebanon; $10,000. Bellevernon Electric Company, Pittsburg; $5,000. Houtzdale Electric Light, Heat and Power Company, Houtzdale; $10,000.

LYONS, N. Y.—Williamson Light and Power Company. To furnish light and power to the residents of Williamson. $10,000. Directors: Judson L. Transue, of Williamson, and Charles and Ray Milles, of Sodus.

GUTHRIE, OKLA.—The Farmers' Mutual Telephone Company, of Greggs, in Comanche county. $30,000. Incorporators: J. P. Lovinger, L. D. Marks, T. M. Brooks, James Gardner, A. H. Collins and T. M. Farris, all of Hasting, and W. W. Welcher, of Comanche, I. T.

COLUMBUS, OHIO—The Cincinnati Independent Telephone Company. $10,000. Incorporators: Charles H. Urban, William Klussman, Edward Puthoff, Arthur R. Morgan and George W. Griffith. Their purpose is the construction and operation of telegraph and telephone lines, either by pole lines or subways, in Cincinnati and the villages of Hamilton county.

DEFIANCE, OHIO—The Northwestern Electric Railway Company. To build an electric road from Defiance to Pioneer, Williams county, to intersect the Toledo & Western *via* Evansport, Bryan and Montpelier. $100,000. Directors: Mayor John F. Crowe, County Commissioner J. H. Miller, Dr. E. Bell, of Cincinnati; Dr. G. A. Rigrish, Judge J. H. Hockman, L. J. Weadlock and J. Harry Kinsley, of Toledo.

ELECTRIC LIGHTING.

LONDON, TENN.—M. R. Goans will install an electric plant at London.

FREDONIA, N. Y.—Fredonia will expend $10,000 in building and equipping a new electric lighting plant.

NORRISTOWN, PA.—Norristown's municipal electric light plant cost $12,800 during 1905, an average of $59.51 per lamp.

FREMONT, OHIO—The Yaryan Company has purchased the plant of the Fremont Electric Light, Power and Gas Company.

SYRACUSE, N. Y.—The transmission line of the Niagara, Lockport & Ontario Power Company has been completed to Syracuse.

PHILADELPHIA, PA.—The United Gas Improvement Company has purchased the electric light plants at Kingston, Nanticoke and Hazleton.

POTSDAM, N. Y.—Potsdam has voted to bond the village for $24,000 for the construction of a municipal lighting plant to supply street lights only.

PASADENA, CAL.—It is reported that the Pasadena city council expects to have the municipal lighting plant in operation before the end of the year.

MEMPHIS, TENN.—The LaClede Gas Company, of St. Louis, Mo., has purchased a site at a cost of $25,000, and will erect a $60,000 electric light plant in Memphis.

DAYTON, OHIO—The Dayton Citizens' Electric Company has filed a bond for $10,000 with the Dayton city auditor, and has begun work on its underground system.

ALBANY, N. Y.—The Hudson River Electric Power Company will be granted a franchise to enter Little Falls. The price agreed upon for street lights is $85 per year per lamp.

GRAND FORKS, MINN.—Edward L. Healy, of Red Lake Falls, has been granted a thirty-year franchise to transmit electric current for lighting and power purposes to Grand Forks.

LOS ANGELES, CAL.—A company, composed chiefly of Los Angeles capitalists, will install an electric light plant at Palms. It is hoped to have the system in operation within ninety days.

BENWOOD, W. VA.—Members of the Benwood council are considering the proposition of erecting a municipal electric light plant. It is purposed to secure a site and install a system at a cost of $10,000.

AURORA, ORE.—The Aurora Electric Company has received an offer for its plant from the Portland General Electric Company. The plant gives service to Aurora, Barlow, Canby, Hubbard and Gervais.

JAMESTOWN, N. Y.—Mayor Weeks has named for the new electric light commission: Louis C. Jagger, Warner F. Liedblad, Clayton E. Bailey and Fred Briggs. The council unanimously confirmed the appointments.

LOCKPORT, N. Y.—The International Power and Transmission Company has filed with the secretary of state a certificate announcing that its principal place of business has been changed from Niagara Falls to Lockport.

CRIPPLE CREEK, COL.—At a regular meeting of the Cripple Creek city council the Frye electric lighting and power franchise was passed with amendments. The franchise will materially cheapen the cost of lighting in the city.

LEXINGTON, N. C.—The Southern Power Company, of Charlotte, has made a proposition to furnish Statesville and other Iredell towns with electric power from Mount Holly, provided they take as much as 2,000 horse-power.

PITTSBURG, PA.—An agreement has been reached between representatives of Pittsburg and the Allegheny County Light Company, by which the company will supply the city with arc lights at $76 per lamp for a period of two years.

NORFOLK, VA.—C. H. Belvin and E. Maxwell have been named by Federal Judge Purnell to take immediate charge of the Cape Fear Power Company, on motion of the Schenectady Trust Company, to foreclose a $350,000 mortgage given in 1903.

BELOIT, WIS.—The Beloit Water, Gas and Electric Company has selected new officers as follows: president, C. B. Salmon, Beloit; vice-president, E. G. Cowdery, St. Louis; secretary and treasurer, Charles H. Deppe, Cincinnati.

BROOKLYN, N. Y.—Commissioner of Water Supply W. B. Ellison has asked the board of estimate to transfer $100,000 unexpended balance to the credit of Manhattan and the Bronx, to the Brooklyn account for an increase in public lighting there and in Queens.

PORTLAND, ORE.—A franchise has been granted by the County Court to the Portland General Electric Company, giving that corporation the right to erect poles along the county roads from Cazadero to Portland for the transmission of electricity from its new power plant to Portland.

WINONA, MINN.—An amendment to the articles of incorporation of the Minnesota Light and Power Company has been filed, increasing the capital stock of the company from $75,000 to $200,000. This provides money for the improvements now being made at the plant of this company.

YORK, PA.—A company to operate an electric plant at Castle Finn has been organized under the title of the Delta Water Company and a charter has been applied for. The incorporators are: J. Howard Stubbs, Robert L. Jones, John R. Williams, Edward W. Evans, Harry P. Reese and R. W. Ramsay.

RHYOLITE, CAL.—R. W. Van Norden, of San Francisco, representing eastern people, has been inspecting the site of a proposed plant that is to be built in Inyo county, California, 100 miles below Bishop, for the purpose of carrying electricity to Bullfrog. He states that work will be begun shortly on a 10,000-horse-power plant.

ACWORTH, GA.—The citizens of Acworth held an election recently to vote on bonds to the amount of $25,000 for electric lights and waterworks, the issue carrying by a good majority. The contract for the plant will be let at once. The bonds, bearing five per cent interest, will be taken principally by the Acworth banks.

SOMERVILLE, N. J.—The initiative has been taken by the new board of town commissioners of Somerville toward the establishment of municipal lighting and water plants. Committees have been appointed to enquire into the cost of lighting in other places of 10,000 inhabitants. The town is at present lighted by the Public Service Corporation.

SAN BERNARDINO, CAL.—The decision in the lighting case of G. E. Cady against the city council of San Bernardino, seeking to break the latter's contract for street lighting with the Lytle Creek Power Company, has been received from Judge Conrey of the Los Angeles Superior Court. The decision holds that the action of the councilmen in awarding the contract to the Lytle Creek company was legal.

ROCHESTER, N. Y.—The Seneca Edison Company has made application to the State Commission of Gas and Electricity for permission to consolidate with the Geneva Power and Light Company. It is understood that the Geneva Power and Light Company is under practically the same control as the Inter-Urban Gas Company which operates under the name of the Seneca Falls & Waterloo Gas Light Company.

DETROIT, MICH.—At a meeting of the Detroit public lighting commission Clifford Elliott was elected president; Marvin M. Stanton, vice-president; Frank T. Bowler, secretary, and William M. Daly, superintendent. Some $40,000 worth of contracts were given out. The Western Electric Company gets the contract for 900 arc lamps at $16,500, and the National Carbon Company will supply carbons to the amount of $10,134.76.

DALLAS, ORE.—The Willamette Valley Company is now operating the Dallas electric light plant. C. B. Rhodes, manager for Dallas, says that the present plant will be rebuilt and remodeled on more extensive plans. The new plant will be built at the Cone mills, and construction will commence immediately. Three hundred horsepower will be the initial capacity, to be increased this fall to 1,000 horse-power. The Dallas plant will be a distributing station, and will furnish light and power to Monmouth and Independence. Mr.

Rhodes says his company will be in a position to furnish power for electric roads if desired.

BRYAN, TEX.—At a meeting of the Bryan city council a franchise was granted Fritz Braatz to install an electric plant.

FREDONIA, N. Y.—The Fredonia village board has decided to expend $10,000 in building and equipping a new electric light plant.

WAYNESBORO, GA.—Waynesboro has voted to issue bonds to the amount of $60,666 for an electric light plant and waterworks system.

CINCINNATI, OHIO—The Cincinnati Gas and Electric stockholders have ratified the plan to lease to the Union Gas and Electric Company.

ALBANY, N. Y.—The trustees of public buildings have awarded to William M. Sheehan & Company the contract for an electric lighting plant in the capitol at a cost of $43,100.

PALESTINE, TEX.—The Palestine Electric Light Company has been awarded a fifty-year franchise and a five-year contract for street lighting. The city pays $7 per month for first fifty arc lights and $6 for all above that number, the city hall to be lighted free of charge.

GALLATIN, TENN.—At a recent meeting of the Gallatin board of aldermen it was shown that Gallatin's electric light plant was a paying investment. The report showed the net earnings for the past twelve months to be $355.81, after deducting all expenses, salaries, repairs, etc.

MEMPHIS, TENN.—Contingent on the passage of an act by congress allowing the construction of locks and dams in the White river in Arkansas is the expenditure of perhaps $1,000,000 for transmitting electrical power for commercial purposes to Memphis. Local capital is interested, and a company may be formed to carry out the plan. The distance of transmission would be about 100 miles.

MIDDLETOWN, N. Y.—The West Branch Light and Power Company has been granted a certificate of authority by the commission of gas and electricity to supply lights in the villages of South Kortright, Hobart and Stamford, Delaware county. Bonds to the amount of $45,000 may be issued by the company, and capital stock to the amount of $5,000. The company also received permission to purchase the stock of the Stamford Electric Light Company.

GAZELLE, CAL.—The survey for a power line from Montague to Dunsmuir has been completed for the Squaw Creek Mining Company. This company will build the power line for the purpose of serving its own mine and mill and the towns of Gazelle, Edgewood, Igerna, Weed, Upton, Sisson, Mott and Dunsmuir with light and power. The Squaw Creek company will not generate its own power, but will purchase it from the Siskiyou Power Company, whose field lies between Yreka and Ashland and beyond into southern Oregon.

RICHMOND, VA.—The joint committees on finance and electricity adopted a motion laying the proposition to establish a municipal lighting plant on the table. The committees decided by a vote of ten to eight that the plan was not practicable, and will ask the council to call for bids for lighting the city by electricity for three or five years, from July 1, 1907. Three propositions were considered. One was the report of the subcommittee, which favored a commercial plant at about $400,000. The second was a substitute, which called for a municipal plant to cost $195,000. A substitute for the whole, which was adopted, was the third.

COLUMBUS, OHIO—Columbus men will take about $100,000 of the underwriting of the Evansville Light Company, a new corporation which has been organized by E. W. Clark & Company and Hodenpyle, Walbridge & Company. The company controls the gas and electric light plants of Evansville, Ind., and has a capitalization of $1,500,000 of common stock and the same amount of six per cent cumulative preferred stock, of which $1,000,000 has been issued. The property is subject to a bonded indebtedness of $1,250,000. The net earnings of the company for the year ending March 31, 1906, were $129,788. The earnings so far this year show a good increase over the same period of last year. The preferred stock will be sold at par with a bonus of thirty-five per cent of the common stock.

ELECTRICAL SECURITIES.

Following a decline on Monday, there was a general rally in the stock market during the balance of the week, and the closing prices showed a net advance as compared with a week ago. In fact, it is believed by many that prices have touched bottom and that liquidation has ceased. A development of much importance has been the renewed interest taken by the outside public, which has for some time held aloof. While buying in this direction has not been heavy, it has nevertheless had a tendency to improve the situation. The money market continues to be a factor. Rates have been firm, though the belief is general that some relaxation may be looked for soon. Crop reports are good and are expected to exert a favorable influence on the stock market, particularly in connection with continued public buying.

ELECTRICAL SECURITIES FOR THE WEEK ENDING JULY 7.

New York:	*Closing.*
Allis-Chalmers common	17½
Allis-Chalmers preferred	46½
Brooklyn Rapid Transit	74⅞
Consolidated Gas	139¼
General Electric	164
Interborough-Metropolitan common	36¾
Interborough-Metropolitan preferred	74¼
Kings County Electric	165
Mackay Companies (Postal Telegraph and Cables) common	72¾
Mackay Companies (Postal Telegraph and Cables) preferred	73
Manhattan Elevated	140
Metropolitan Street Railway	103
New York & New Jersey Telephone	120
Western Union Telegraph	92
Westinghouse Manufacturing Company	151

The first quarterly dividend of 1½ per cent upon the stock of the Third Avenue Railroad Company will be payable on July 31. Books closed July 13 and reopen August 1. The placing of the stock upon this dividend basis at this time was one of the conditions of the lease to the Metropolitan Street Railway Company. This rate will continue for four years, after which the rate must be raised to 7 per cent per annum.

Boston:	*Closing.*
American Telephone and Telegraph	132
Edison Electric Illuminating	240
Massachusetts Electric	69
New England Telephone	130
Western Telephone and Telegraph preferred	91
Philadelphia:	*Closing.*
Electric Company of America	11⅝
Electric Storage Battery common	67½
Electric Storage Battery preferred	67½
Philadelphia Electric	8
Philadelphia Rapid Transit	25
United Gas Improvement	84¼
Chicago:	*Closing.*
Chicago Telephone	116
Chicago Edison Light	138
Metropolitan Elevated preferred	67
National Carbon common	85
National Carbon preferred	119
Union Traction common	4
Union Traction preferred	14

Oak Park Elevated for the year ended June 30 carried a daily average of passengers, including transfers, of 47,256, an increase of 1,357.

Metropolitan Elevated June daily average was 133,974, an increase of 9,395.

The South Side Elevated daily passenger average for June was 101,770, an increase of 7,829.

Northwestern Elevated daily passenger average for June was 80,165, an increase of 4,328. The total number of passengers carried during the year ending June 30 was 29,132,871, an increase of 2,320,046. The revenue from the traffic was $1,456,643, an increase of $116,002.

INDUSTRIAL ITEMS.

THE ALLIS-CHALMERS COMPANY, Milwaukee, Wis., in bulletin No. 1051 describes Allis-Chalmers alternating-current generators, belted type.

THE SEYMOUR MANUFACTURING COMPANY, Seymour, Ct., is able to supply for prompt shipment German silver, wire, rods, sheets, blanks, etc., also phosphor bronze.

THE STANLEY-G. I. ELECTRIC MANUFACTURING COMPANY has opened a sales office, under the management of C. A. Mann, at 822 New York Life Building, Omaha, Neb.

THE WESTINGHOUSE ELECTRIC AND MANUFACTURING COMPANY, Pittsburg, Pa., has removed its Salt Lake City (Utah) office to 212-214 South West Temple street. The Dallas (Tex.) district office has been removed to 418 Main street.

THE PITTSBURGH TRANSFORMER COMPANY, Pittsburgh, Pa., has issued a folder containing letters commendatory of the performance of the company's transformers when subjected to lightning discharges. There is also being distributed the July calendar card.

THE SOLAR ELECTRIC COMPANY, 161 South Canal street, Chicago, Ill., offers a color cap made of natural colored glass, which slips on the large end of any ordinary incandescent lamp and gives an attractive color effect for lighting electric signs and store windows.

THE PRINGLE ELECTRICAL MANUFACTURING COMPANY, INCORPORATED, 1906-1908 North Sixth street, Philadelphia, Pa., is the new title of a company formed from the business previously conducted by W. T. Pringle. This company manufactures electrical specialties.

THE GAIL-WEBB MANUFACTURING COMPANY, Buffalo, N. Y., is marketing a new holder for incandescent lamps which is particularly desirable for shops, draughting houses, etc., as the adjustments are such that the lamps may be placed in any position and held rigidly in place.

THE CHICAGO PNEUMATIC TOOL COMPANY, Chicago and New York, is now placing a great many of its air-cooled "Duntley" electric drills. These drills are wound for 110 and 220 volts, direct current only, and the company claims to consume less energy and develop more power than any other portable drill on the market.

THE AMERICAN TELEGRAPHONE COMPANY has begun the erection of a manufacturing plant at Wheeling, W. Va. For some time a corps of experts has been perfecting the company's apparatus for commercial purposes, and it expects shortly to be in a position to meet the demand, which, it is stated, is at present greatly in excess of the supply.

THE BECK FLAMING LAMP COMPANY, 58 West Fifteenth street, New York city, is now well equipped with laboratories and offices at this address, and a factory is being established at Weehawken, N. J. Louis J. Auerbacher is president of the company. The Beck form of electric arc lamps was illustrated and described in the ELECTRICAL REVIEW some weeks ago.

THE DE LA VERGNE MACHINE COMPANY, New York city, has published a forty-eight-page pamphlet describing various types of horizontal and vertical ammonia compression refrigerating machines and equipment for ice plants, breweries, packing houses, etc. The book is illustrated by a number of half-tones, a feature of the illustrations being the arrangement of composite views of plants installed in various parts of the world.

THE STROMBERG-CARLSON TELEPHONE MANUFACTURING COMPANY, Rochester, N. Y., reports having closed contracts for switchboards at the following places: Knox, N. D.; Lowville, N. Y.; Adams, N. Y.; Paola, Kan.; Fort Wayne, Ind.; Camillus, N. Y.; Superior, Wis.; Holloway, Minn.; Pine Bluff, Ark.; Sioux City, Iowa; Chicago, Ill.; Louisville, Ky.; Ravenswood, W. Va.; Dundas, Ill.; New York, N. Y.; Kansas City, Mo.

THE HARTMAN CIRCUIT-BREAKER COMPANY, Mansfield, Ohio, is now manufacturing an electrically controlled high-tension oil switch. In operation the current is derived from the exciter, a storage battery or any convenient source of direct-current supply, and the operating solenoids may be wound for any standard voltage. This type of switch has some individual characteristics of which the bulletin published by this company gives an excellent description.

THE NEW YORK TELEPHONE COMPANY announces a record-breaking increase in business for the month of June. This company, with the New York & New Jersey Telephone Company, has gained in the five boroughs of Greater New York 3,591 new telephones, which is 1,374 more subscribers than they gained during June a year ago. The total gain for the first six months of the present year is 21,057, which makes a total of 263,000 telephones now in service and under contract in Greater New York.

THE PACIFIC ELECTRIC AND MANUFACTURING COMPANY, Napa, Cal., has been organized to manufacture and sell high-tension switches for indoor and outdoor use, and also high-tension line appliances. Arrangements have been made with F. G. Baum for the right to manufacture the oil switches and outdoor switches designed by him. These, it is stated, have given remarkable satisfaction in service. A bulletin describing the product is being prepared, and the company will be pleased to send full information upon request.

THE CROCKER-WHEELER COMPANY, Ampere, N. J., reports the following orders for generators: Emfield Construction Company, Windsor Locks, Ct., one 180-kilowatt, three-phase, sixty-cycle, 2,300-volt, and one belt-type, 165-kilowatt, three-phase, sixty-cycle, 2,300-volt alternating-current machines. Warwick Iron and Steel Company, Pottstown, Pa., one direct-current generator, 150 kilowatts, 250 volts, for additional power for shop equipment. Fitchburg & Leominster Street Railway Company, Fitchburg, Mass., one 100-kilowatt, direct-current generator at 550 volts.

THE DE VEAU TELEPHONE MANUFACTURING COMPANY, 27 Rose street, New York city, will be represented at the convention of the National Electrical Contractors' Association by its president, Albert S. De Veau. This company is said to be the oldest independent manufacturing telephone company in this country, as it was established when the industry was in its infancy, and has been continued without interruption. The company makes an especially complete line of interior and intercommunicating telephone apparatus, and its equipments for the various interior services are now recognized as accomplishing the highest rating of success.

THE ELECTRIC SERVICE SUPPLIES COMPANY, Chicago, Ill., is issuing a unique little house organ known as "The Keystone Traveler," and it is its purpose to issue this booklet at intervals in the future. As recently published, this company is a consolidation of the business of Mayer & Englund, Philadelphia, Pa.; Porter & Berg, Chicago, Ill., and the Garton-Daniels Company and Electric Devices Company, Keokuk, Iowa. The first issue of the new publication has excellent pictures of the personnel of the new organization, and a general description of the products manufactured, which include street railway equipments and the Garton-Daniels lightning arrester.

THE CUTTER COMPANY, Philadelphia, Pa., in order to more advantageously handle its foreign business, has established offices and stores at 20 Great Russell street, London, W. C., England. W. E. Gibson will be resident manager. Mr. Gibson is well known in this country, having been associated with Robert W. Blackwell & Company. Mr. A. Edward Newton, president of the Cutter Company, will sail for Europe very shortly in the interests of the English branch. The Cutter Company's apparatus, it is stated, has met with a high degree of success abroad. There is now being distributed the 1906 edition of the company's "I-T-E" circuit-breaker catalogue. This contains 196 pages, nine by eleven inches, and very completely illustrates and describes the company's product, giving prices, code words and ratings. It will be sent free of cost, expressage prepaid, on request, to patrons and consulting engineers. To others the price is $1. Bulletins Nos. 99 and 100 describe and illustrate, respectively, the application of storage batteries to railway car lighting, and their application in railway electric signal and interlocking devices.